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THE
GEOGRAPHICAL REVIEW

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RECENT EXPLORATIONS ON THE CANADIAN ARCTIC COAST*

By RUDOLPH MARTIN ANDERSON
Chief of the Southern Party, Canadian Arctic Expedition, 1913-1916

The Canadian Arctic Expedition consisted of two main divisions, the Northern Party, commanded by Vilhjalmur Stefansson, and the Southern Party, under my direction. The Northern Party was to devote its chief attention to the Beaufort Sea in the region west of the Parry Archipelago and north of Alaska and Yukon Territory. The Southern Party planned to explore the northern coast of Canada between Cape Parry (124° W.) and Kent Peninsula (108° W.). It was arranged to have its surveys extend inland about 100 miles and also cover the southern and eastern portions of Victoria Island. The scope and variety of the scientific work called for a staff of specialists, and we were fortunate in securing trained and experienced men whose devotion to the arduous and prolonged field work is a token of the value of their results.[1]

We cleared from Nome in the gasoline schooner *Alaska*, July 19, 1913, reaching Point Barrow on August 19, after some difficulty with gales in Bering Sea and Kotzebue Sound. The gasoline schooner *Mary Sachs*, an

* Published by permission of the Deputy Minister, Department of Mines, Ottawa, Canada.

[1] The Southern Party included one geologist, Dr. J. J. O'Neill of the Canadian Geological Survey; two topographers, Mr. Kenneth G. Chipman and Mr. John R. Cox of the Topographic Division of the Geological Survey; two anthropologists or ethnologists, Mr. D. Jenness of New Zealand, an Oxford man with field experience in New Guinea and elsewhere, and M. Henri Beuchat of Paris, who had gained distinction by writings on American archeology; a meteorologist and magnetician, Mr. William Laird McKinlay of Glasgow University; a marine biologist who also studied the plants and insects, Mr. F. Johansen, recently of the Department of Agriculture at Washington, and a former member of the Danish East Greenland Expedition, under the late Mylius Erichsen; a photographer and cinematographer, Mr. George H. Wilkins of Adelaide, Australia; and the leader, who, as a zoölogist of the Geological Survey, was to study birds and mammals and collect specimens for the Victoria Memorial Museum at Ottawa.

Owing to the complications which arose over our not connecting with the *Karluk* at Herschel Island, one of the anthropologists, Mr. Beuchat, and the meteorologist, Mr. McKinlay, were not able to join the Southern Party, and the cinematographer, Mr. Wilkins, was able to be with us for only a small part of the time. Mr. Jenness was able to cover most of the proposed field, however, and, by division of labor, complete meteorological observations were obtained. The magnetic instruments were lost on the *Karluk*, and that branch of science was not represented in the final results.

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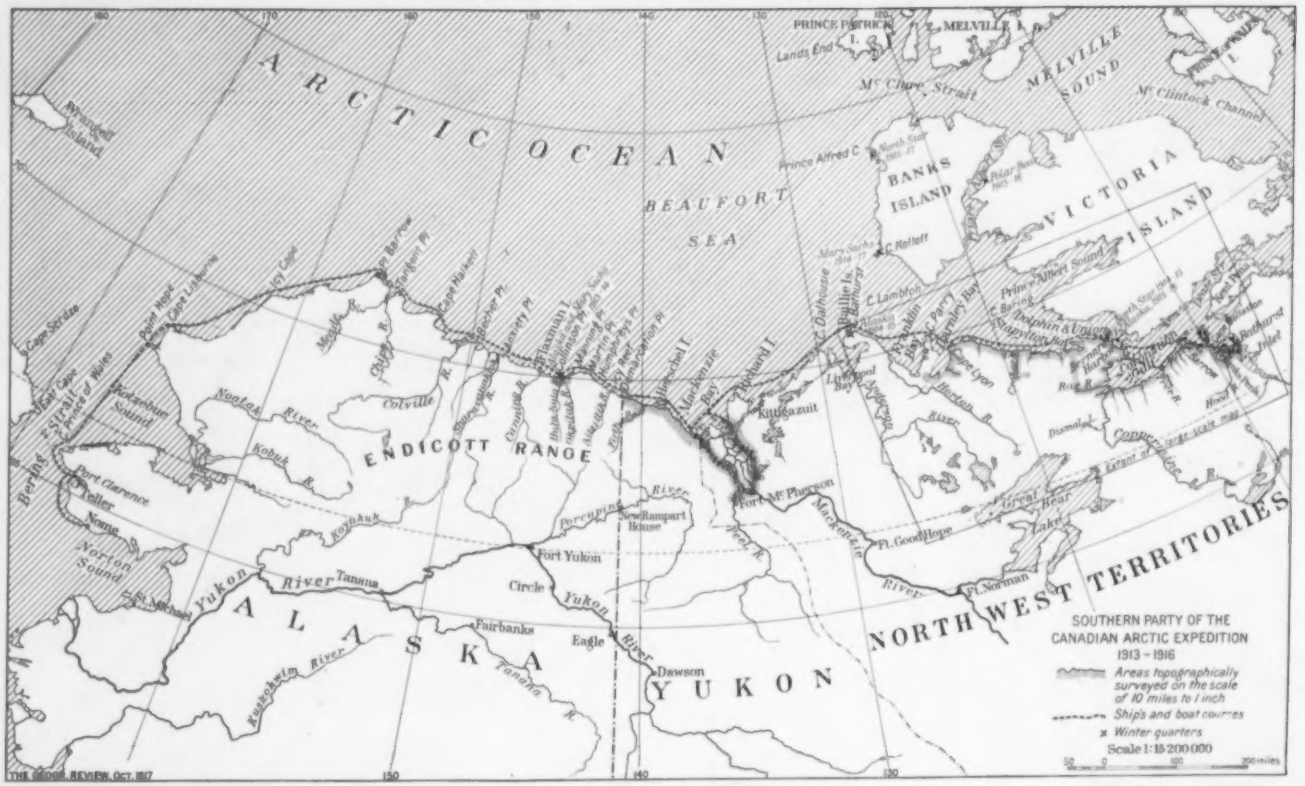


FIG. 1—General map of the Arctic coast of Alaska and northwestern Canada showing the field of activity of the Southern Party of the Canadian Arctic Expedition of 1913-16. Scale, 1:15,200,000. The rectangle on the right indicates the extent of the detailed map, Figure 2.

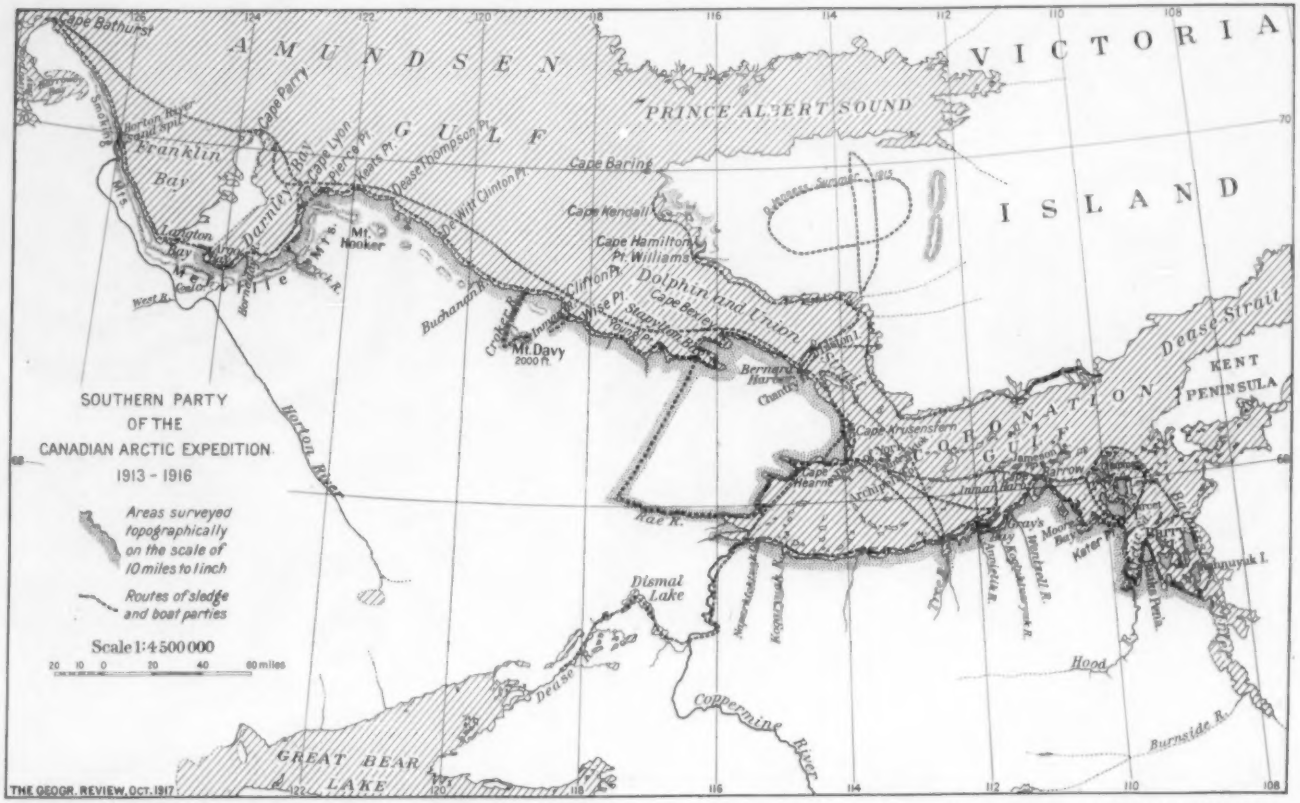


FIG. 2—Map of a portion of the Arctic coast of northwestern Canada showing in detail the field of activity of the Southern Party of the Canadian Arctic Expedition of 1913-16. Scale, 1:4,500,000.

auxiliary freighter for the expedition, sailed about the same time. Like most vessels starting out for a long Arctic sojourn we were overloaded. In addition to our scientific equipment we had provisions for three years and various supplies, which included almost everything from a needle to an anchor. The decks were encumbered with lumber, sledges, dogs, dredges, and all the miscellaneous gear that was dumped on top because there was nowhere else to put it.

East of Point Barrow we found the Arctic Ocean practically filled with heavy ice. In that part of the world there are no true icebergs; but enormous pressure ridges often form along tide-cracks or are heaped up by gales along the edge of the floe fields, where they are cemented by spray and by spring thaws and augmented by snowdrifts. These masses are sometimes of immense size, rising thirty or forty feet out of the water—too large to melt during the short summer. The ice conditions east of Point Barrow seem to depend largely upon the prevailing winds during the early summer. If the winds are easterly the ice masses move out to the northwestward of Point Barrow and Wrangell Island, leaving an open ocean for navigation. If the winds are westerly the great ice-pack is jammed against the northern coast of Alaska and the region about the mouth of the Mackenzie, where there is no easterly exit.

In 1913, for the first time in about twenty-five years of whaling in that region, no ship from the west was able to reach Herschel Island. It was known as "a bad ice year." Of the ships caught in the ice two were sunk. As usual when the sea is filled with great masses of ice, the temperature of the water and the air was much lower than normal, snow squalls were frequent, young ice kept forming in the spaces between the larger ice cakes, and the solid freeze-up occurred a month earlier than normally. The occasional large masses scattered among the crushed-up areas of bay ice are an advantage to vessels of small draught. The large ice cakes ground on the gradually shoaling bottom some distance off shore, and small vessels can get shelter by tying up behind them. The ice would occasionally relax its grip on the coast and move off half a mile or so with changes of tide or wind, and the vessels could creep ahead a little. The *Alaska* and *Mary Sachs* were finally obliged to give up hope of getting farther than Collinson Point, Alaska, 69° 59′ N. and 144° 50′ W., and decided to go into winter quarters September 10.

At Collinson Point luckily we fell heir to a large, recently abandoned log cabin, well built of driftwood logs, and driftwood fuel was abundant, as it is in most places on the coast for two or three hundred miles on either side of the Mackenzie River delta. Game was scarce, as the caribou have been nearly exterminated on the Arctic coast of Alaska, but some mountain sheep and a small amount of caribou meat were brought down by inland Eskimos.

The men of our party rapidly became used to outdoor life and travel in

the Arctic and the technique of making scientific observations at low temperatures. A snow house makes a good observatory, although at 40° below zero a light breath or even the invisible vapor from a bare, warm hand will speedily cause a film of fog or frost to form on lenses and all metal parts. Even guns are kept outside all winter, for if taken indoors they instantly become coated with heavy white frost and drip water as the metal becomes warm, causing rust inside and out if they are not taken apart and cleaned soon after.

In February O'Neill and Cox started for the international boundary (141st meridian), about 100 miles east of our winter quarters, to complete the survey from the boundary to the Mackenzie River, connecting with the survey made by the International Boundary Survey party in 1912. This spring's work and that of the next two seasons demonstrated that very little accurate topographical surveying on the lines laid down for us (ten miles to the inch, with control stations at frequent intervals) could be done before the middle of March. Some compass lines could be run before that time, where salient points were already located, but earlier in the season the sun is too near the horizon to get satisfactory observations, on account of the refraction. Blizzards and clouded skies are so frequent that calculated occultations of stars and planetary satellites rarely can be observed at a stationary observatory and are of little use in field work.

In addition to the coast survey from the international boundary, there was carried out a geological traverse up the Firth River (Herschel Island River) into the Endicott Range and a geological reconnaissance of Herschel Island.[2]

As soon as the Mackenzie River ice broke up, Chipman surveyed the east branch in company with O'Neill, and Cox surveyed the west branch. This survey shows the west branch to have a channel at least six feet deep through the shoals at the entrance into the deep water of the river. The east branch has a channel with about the same depth of water. The middle branch, which is supposed to be the deepest, was not surveyed because the boat parties had to join the *Alaska* at Herschel Island and go east to their main field of work. The Mackenzie furnishes an immense waterway, for boats drawing not more than six feet, southward as far as Great Slave Lake, where shoals at a depth of about five feet form a barrier at low-water stages. Otherwise there is deep water from the coast up stream as far as Fort Smith, on the 60th parallel.[3]

Herschel Island, Y. T., 69° 34′ N., 138° 54′ W., is quite a busy place in July and August. Eskimo whaleboats to the number of twenty-five or more and perhaps a dozen two-masted Mackenzie-built schooners are usually assembled here to trade with incoming ships; and in 1915, the Hudson's Bay Company established a Western Arctic district with headquarters at

[2] *Summary Rept. Geol. Survey of Canada for 1915*, Dept. of Mines, Ottawa, 1916, pp. 236-237.
[3] *Ibid.*, pp. 237-239.

FIG. 3—House used by Southern Party of Canadian Arctic Expedition as base from 1914 to 1916.

FIG. 4—Camp near northern limit of trees on east side of Coppermine River, near Sandstone Rapid. Trees here are thick at their bases, but rapidly taper off. Note large number of dead trees, mostly killed by bark-beetles. February 15, 1915.

Herschel Island. Other posts were founded 150 miles east of the Mackenzie at Baillie Island or Cape Bathurst, 70° 35′ N., 128° 5′ W., and at Kittigazuit (the old Point Encounter of Sir John Richardson) at the eastern edge of the Mackenzie delta, the site of one of the largest villages of the Mackenzie Eskimos. In 1916, the company moved 400 miles farther east and established a new post at the station just vacated by the Southern Party in Dolphin and Union Strait (Bernard Harbor). These new posts of the "Big Company" are supplied by a gasoline motor schooner, the *Fort McPherson,* from the large storehouses at Herschel Island stocked by chartered ships sent up from Vancouver.

The importance of the animal life of the northland of Canada has been recognized for hundreds of years, so much so that all the northern regions were long known as the "Fur Countries." Of the total amount of fur produced, the Arctic realm itself has not furnished so much as the wooded country farther south, partly because of its greater barrenness and inhospitality, which results in fewer valuable species than the timbered country produces, partly because of fewer natives, and partly because of its inaccessibility. In recent years, however, owing no doubt to greater competition among fur traders outside, the advance of trade into the north has been rapid, both by the large companies and by small independent vessels, free traders, and trappers.

In traveling over the Arctic lands, we find few regions so inaccessible or desolate that they can not support at least some natives who have been schooled by necessity to make use of meager resources. When the country is ultimately opened up, to a much greater degree than at present, and developed for its timber resources in the more southerly portions and possibly for mineral wealth farther north, the game of the country may by proper conservation become a valuable asset and the fur industry still remain of importance in vast regions which may have no other use.

The *Alaska* left her first winter quarters at Collinson Point on July 25, 1914, the first day the ice moved off shore, and, after some blocking by ice, reached Herschel Island on August 5. The *Mary Sachs* arrived a little later. These expedition vessels were the first ships to come into Canadian waters in the western Arctic flying the Canadian flag. Stefansson had started from Martin Point, Alaska, in March on an ice exploring trip. His support party had returned in April, but Stefansson and his two seamen, Storker Storkerson and Ole Andreason, had not returned. If they had returned to the mainland in the spring they would have been heard from sooner, and our knowledge of their proposed plans made it evident that they had gone on towards Banks Island. The *Mary Sachs,* with a full equipment for two years and under the command of George H. Wilkins, sailed for Banks Island August 11, and found Stefansson's party near Cape Kellett early in September.

On August 17 the *Alaska* left Herschel Island eastward bound, was

delayed by ice between the island and Shingle Point (on the west side of the Mackenzie delta), and reached Baillie Island (Cape Bathurst) on August 21. Sailing through smooth summer seas that were free of ice, we reached our goal at Bernard Harbor, Dolphin and Union Strait, 68° 47′ N., 114° 50′ W., in the evening of August 24. After the stores had been unloaded and the members of the scientific staff had disembarked, the *Alaska* returned to Herschel Island but was prevented by bad weather and ice conditions from returning farther east than Cape Bathurst in 1914.

As soon as the ice was good for travel I set out on the 400-mile trip along the coast from Cape Bathurst to join the rest of the party at Bernard Harbor. At Keats Point we met O'Neill and Chipman, who were making a preliminary reconnaissance trip along the coast, and we reached the base station together on Christmas Day, 1914. They had found the fogs and blizzards of autumn very unsatisfactory for survey work, though the temperature was scarcely ever below zero Fahrenheit even during December. When we met them they had been held in camp for six days, with strong head winds and blizzard, while we had been able to travel part of the time with fair wind, which makes a tremendous difference.

Detailed Survey Work

O'Neill and Chipman made a detailed survey of this coast in March, April, and May, 1915, filling in the blank unexplored section of Darnley Bay between Cape Parry and Cape Lyon, fixing the position of Hornaday River[4] flowing into the south side of Darnley Bay, and going some distance up the river flowing into the southeast side of the bay. For the convenience of future travelers, we have adhered to the policy of retaining the native place names wherever these could be ascertained, but as this particular stretch of coast is uninhabited, we have proposed the name "Brock River" for the southeastern river, in honor of Major R. W. Brock of the Canadian Expeditionary Forces, recently Director of the Geological Survey, to whose active interest in northern geology the organization of the geological and topographical sections of the expedition was largely due. After a long trip up the Coppermine to the Dease River, I went west along the coast in the spring to reinforce the western survey party. At the same time Cox mapped the west end of Coronation Gulf, ascended the little-known Rae River about seventy miles to the junction of two small creeks which unite to form it, and then made an overland portage to Stapylton Bay, cutting through the middle of another large unexplored district. Large willows were found at frequent intervals on the Rae River after he had penetrated some miles from the coast, but no spruce or other timber was found. The rock exposures were the prevailing dolomite of the region, with diabase near the mouth of the river. Caribou were seen migrating northward nearly every day during the early part of May, in the Rae River region.

[4] A. J. Stone: Some Results of a Natural History Journey, etc., *Bull. Amer. Mus. Nat. Hist.*, Vol. 13, 1900, pp. 31-62.

The country west of Coronation Gulf is mostly drift-covered, with occasional exposures of dolomite in sea cliffs and in the river valleys. There is a little conglomerate near Buchanan River, and a few dikes of diabase occur in the Darnley Bay region and for some distance east of Cape Lyon. These dolomite cliffs are also typical of southwestern Victoria Island. At Point Williams and Cape Hamilton are vertical dolomite cliffs about 125 feet high, where hundreds of gulls nest in niches in their face. Rock fossils are extremely rare, but several species of Silurian corals were found on Liston Island in Dolphin and Union Strait. Large numbers of king eiders and Pacific eiders nest on small islands on both sides of Dolphin and Union Strait, but this particular district seems to be too dry and too barren to support any kind of shore birds or land birds in large numbers.[5]

The western survey having been finished late in May, O'Neill and Cox started eastward from Bernard Harbor on June 9. The expedition had always prided itself on being thoroughly prepared and equipped to take the field and work at any season and under any conditions. These problems of equipment embraced winter and early spring sledging with tent and snow house, using either wood alcohol, Primus oil stove, or native blubber lamp; late spring travel on either ice or water; summer travel with boat or canoe; and overland packing by men and dogs in summer.

In Coronation Gulf the ice was still solid in June, but there was the possibility of cracks and leads to cross later, and boat work after the break-up. The Northern Party had made good use of waterproof tarpaulins in constructing sled rafts to cross leads, being unable to haul canoes over the rough ice. This made no provision for travel after the break-up of the ice.

We made very satisfactory provision for this kind of travel by strengthening the stern timbers of a large Point Barrow whaling umiak, 28 feet long and covered with heavy bearded-seal skins, providing for the attachment of an Evinrude motor and carrying the umiak on a low ivory-shod boat sled. In the spring, a few dogs could haul this boat with ease, carrying several hundred pounds of baggage inside, and it could be unshipped and launched in a few minutes whenever a ferry was needed. In fact, if the ice should break, the canoe would be loaded and launched automatically. Later in the season the umiak with from two to four men, three dogs, and a thousand pounds or more of guns, gear, grub, and gasoline, made from five to six miles per hour, weathering some pretty stiff seas. It could be beached on any kind of coast in a hurry, by rolling it up on inflated sealskin "pokes," a great advantage when exploring a coast whose harbors are unknown and a sudden breeze raises a dangerous lop in a very short time. The umiak is very useful among ice-floes, as it is practically impossible for it to be stove; it can easily be hauled up on an ice cake, and it will also stand bumping

[5] *Summary Rept. Geol. Survey of Canada for 1915*, Ottawa, 1916, pp. 220-239.

over the boulders on a river bottom which might prove disastrous to a wooden boat.

The canoe party crossed Coronation Gulf direct from Cape Krusenstern to the mouth of Tree River, 67° 46′ N., 111° 59′ W., being delayed by but one large crack. This route leads past numerous islands, including the Duke of York Archipelago. These islands, of which the Pauneraktok group are typical, have in most cases precipitous cliffs of diabase, frequently overlying sandstones, facing the south or southeast and sloping down on the north and west sides. Part of June and all of July were spent around Port Epworth or Tree River (Kogluktualuk of the Eskimos). A little west of Tree River granite rocks begin to appear. On the south side of Coronation Gulf the granite is overlain in places with shale, limestone, or sandstone; on Gray's Bay by schist; on Bathurst Inlet by dolomite and quartzite; and throughout the whole area frequently cut by dikes and capped over large areas by sills or flows of basalt or diabase.

Tree River was explored on a packing expedition some distance inland. It is said to have one of its heads near the Coppermine, and to have spruce trees on one branch. Like all the other streams of this region (in the granite area) it has rapids, cascades, and falls a few miles from its mouth, and is full of fish in the summer time. Several families of Eskimos usually spend the summer at the first cascade, catching fish by spear and hook, and by raking with a sort of double gaff-hook. Salmon trout and whitefish are largely caught in the rivers, while large lake trout are caught in nearly every lake of any size.[6]

Chipman and I brought a small gasoline launch to Cape Barrow (68° 1′ N., 110° 59′ W.) on the schooner *North Star* on August 12, met the canoe party, and operated with them for the remainder of the season, surveying Moore Bay, Arctic Sound, Hood River, Barry Island, and other parts of Bathurst Inlet. Parts of this region had not been visited since Franklin in 1821, or Dease and Simpson in 1837 and 1838, and, as these explorers had only made a hurried trip with canoes and cut across many points without careful examination, we made many interesting discoveries in the intricate system of deep, narrow fiords and numerous islands in Bathurst Inlet.

Cape Barrow, or Haninnek, as it is called by the Eskimos, is a mountainous granitic region, but is not nearly so high as stated by Franklin in 1821. He says: "The higher parts attain an elevation of 1,400 and 1,500 feet and the whole is entirely destitute of vegetation."[7] In 1915 we found the height of the highest of the granite ridges to be 340 feet above sea level by aneroid, and although the hills have a barren appearance on their summits and slopes, careful inspection shows many bright green patches in the little valleys and gullies, where soil has collected, as well as in basins in the rocks,

[6] *Summary Rept. Geol. Survey of Canada for 1915*, Ottawa, 1916, pp. 240-241.

[7] John Franklin: Narrative of a Journey to the Shores of the Polar Sea, London, 1823, p. 369; also as reprint in "Everyman's Library," p. 375.

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 5—Start of survey party from Bernard Harbor, Dolphin and Union Strait, with skin umiak on boat-sled, June 9, 1915. The umiak is "bowsed up" across top to prevent breaking keel on sled. Evinrude motor, gasoline, and excess baggage carried inside canoe hauled easily by five dogs.

FIG. 6—C. G. S. *North Star* leaving the small deep harbor at Cape Barrow, Coronation Gulf. Harbor surrounded by granite rocks. Jameson Islands visible to the northward, in the background. August 12, 1915.

FIG. 7—Rock cairn, forming cross 12 feet high, erected by Dease and Simpson in 1839, on point between Port Epworth and Gray's Bay. Left to right: J. R. Cox, J. J. O'Neill, K. G. Chipman. September 30, 1915.

FIG. 8.

FIG. 9.

FIG. 10.

FIG. 8—Eskimo village of snow houses and caribou-skin tents on island near mouth of Coppermine River, Coronation Gulf, October 27, 1915. The Eskimos here have recently arrived from their annual autumn caribou hunt inland and are preparing to go out on the ice sealing later.

FIG. 9—Eskimos coming down the Kogluktualuk (Tree) River from the first rapids, where they have spent the summer fishing. This man has an extemporized sled made by lashing together green willow saplings to form a frame and building up the runners of mud and tundra muck frozen on and coated with ice.

FIG. 10—C. G. S. *Alaska*, loaded and ready to sail out, in Bernard Harbor, July 12, 1916.

around the little lakes—green grass, low dwarf willow, deep tundra moss, cotton-grass or "nigger-head" tussocks, heather growing luxuriantly on many shelving rocks, and about ten species of flowering plants in bloom close to our camp on August 13, 1915. The summits of the granite ridges in general were covered with gray lichens. In this region we were often deceived by great reddish areas on cliffs, which had the appearance of ferruginous rock, but upon closer examination proved to be only a dense coat of red lichens.

A considerable copper-bearing area was found in Bathurst Inlet and was followed up, with a view to making a detailed geological sheet of an important area rather than attempting to make a complete survey of the head of Bathurst Inlet outside the copper area. The scenery in Bathurst Inlet is most striking, cliffs of dolomite overlain by diabase rising to a height of 870 feet in the Banks Peninsula region, at Cape Wollaston, the north end of Banks Peninsula, 67° 38′ N., 108° 40′ W., and to over 600 feet on Barry Island. Caribou were seen at Kater Point, near Hood River, and on Kannuyuk Island, and were taken without difficulty when we needed meat. A large Barren Ground bear was killed on Arctic Sound. Two wolverines were shot and others seen, the species being surprisingly common far north of the timber line in this region.

Among the points of interest noted on the south side of Coronation Gulf west of Cape Barrow was the great length of Inman Harbor, a very deep, narrow fiord, the head of which is separated by a low portage of half a mile from another deep inlet running in from the east side of Cape Barrow, nearly making an island of the Cape Barrow peninsula. West of Cape Barrow there are three fairly large rivers flowing into Gray's Bay. The eastern is called Utkusikaluk (charted at its mouth by Sir John Franklin in 1821 and by him named the Wentzell River), the middle and apparently the largest river is called Kogluktuaryuk, and the western, Annielik (incorrectly indicated on Hanbury's map[8] as the Unialik). Tree River, or Kogluktualuk, flows into a fine large bay called Port Epworth, about 65 miles east of the Coppermine; about 25 miles west of Tree River is the big Kogaryuak, and about 18 miles from the Coppermine River is a smaller stream also called Kogaryuak by the natives. All of these rivers have falls or rapids a very few miles from the coast.

We got our two boats back to Tree River just before the freeze-up, which occurred on October 5. Sleds had been cached there, and the surplus dogs had been left at the fishing-place for the summer with some local Eskimos. Dried fish had been cached here in the summer, fat caribou meat was obtained in the fall, and, by frequently dropping a net for fish, shooting caribou, Arctic hares, and other game when needed during the summer, we had been enabled to keep a large stock of reserve provisions and had no hardship in waiting at Tree River for about three weeks, until the ice of

[8] D. T. Hanbury: Sport and Travel in the Northland of Canada, London, 1904.

Coronation Gulf became strong enough for us to start for home on October 27 without following all the indentations of the coast. We reached Bernard Harbor station with our sleds November 9, 1915, and received the first news of the loss of our friends on the *Karluk* and of the European War, when it had been raging for over fifteen months.

Migration of the Caribou

An interesting and important feature of the Coronation Gulf region is the migration of the Barren Ground caribou from the mainland northward to Victoria Island in April and May, and a southward migration as soon as the ice is strong enough for crossing again in November. The exact crossing place of the larger herds seems to vary from year to year. Thus, in 1914, the straits froze over very late and the caribou from the north bunched up on the south shore of Victoria Island. Being unable to cross they slowly drifted eastward along the coast and crossed Coronation Gulf mainly east of Cape Krusenstern. In 1915 they crossed in large numbers at Bernard Harbor around the middle of November, and in a few days we stowed away forty-five prime carcasses for our winter meat supply. Cold storage is simple. By merely keeping it under cover, meat remains frozen until June. Very few caribou are found around Dolphin and Union Strait coast in winter, although a few stragglers have been seen. In three different years I have found them in fair numbers near the coast around the mouth of the Coppermine River.

Arctic Timber Areas

The northern limit of spruce trees on the Coppermine River is about 20 miles from the coast, although some stragglers are found growing five to ten miles from the coast on Naparktoktuok Creek, a few miles east of the river. Willows of good size, and from ten to fifteen feet high, are found in many places north of the tree line, and persist until they dwindle to small ground-creeping shrubs on the northern islands and wind-swept mainland coast.

To the west there are no trees anywhere near the coast until we come to Franklin Bay, where we find spruce of fair size ten or fifteen miles inland in the valley of Horton River. Spruce comes rather close to the coast on the Anderson River south of Liverpool Bay. Still farther west we find the great northward extension of timber in the Mackenzie delta, fair-sized trees occurring northward nearly to Richard Island about 150 miles north of the Arctic Circle.

On the Horton River, the Coppermine River, around Dismal Lake, and to a less extent farther west, we often noted the large proportion (in some places 90 per cent) of dead spruce trees near the northern limit of timber. There seemed little evidence of fire destruction, and the explanation that the northern regions are becoming colder and the vegetation retreating

seemed inconclusive. On one of our winter trips Mr. Johansen accompanied a sledge party southward to the timber line on the Coppermine River and made a careful study of conditions. He found that practically all the dead trees showed traces of the ravages of bark beetles, three species of them being found.

Survey of the Unexplored Croker River

After returning from the Coppermine River trip, Mr. Chipman and myself made a survey for some distance up the Croker River, the largest river flowing into Amundsen Gulf, between Darnley Bay and Coronation Gulf. The mouth of the river is indicated on Franklin's and Richardson's maps, about fifteen miles west of Clifton Point (69° 13′ N., 118° 40′ W.), and Richardson mentions the size of its delta. The river itself was of particular interest to us because it promised to give an important geological section into the heart of the Barren Grounds halfway between O'Neill's reconnaissance in from Darnley Bay and Cox's traverse from Rae River to Stapylton Bay, the whole intervening country inland having been hitherto a *terra incognita*.

The apparent size of the river at the coast, where it spreads out into a triangular delta about five miles on each side, is larger than the actual volume of the river bears out, for, before emerging from its dolomite box-canyon about five miles from the coast, the river averages only about sixty yards in width. It probably carries considerable water for a short time, as the snow melts very rapidly on the Barren Grounds in spring and the ice breaks up early.

The deep and strikingly picturesque canyon of Croker River was unsuspected, as the surrounding country is rather gently rolling and one could come within a mile of the gorge without seeing any sign of it. We found that the river had cut a vertical-walled canyon through yellow dolomite rock for over twenty miles, averaging three hundred feet in depth for most of the distance, with no way out of the gorge at the sides for miles. Remarkable pillars and castellated rock effects were frequent.

Heavy snowdrifts (due to the prevailing winds) overhung the west bank of the river in immense cornices in many places, and there had been great avalanches here and there that made barrier ridges of hard, icelike, angular-fractured snow blocks extending most of the way, and sometimes all the way, across the river. The river continually makes short, sharp bends, but its general course is northerly. It finally became so obstructed by avalanche barricades that we could scarcely take a loaded sled over them and were obliged to cache most of our load. Farther up the river seemed to have quite a steep descent, with some rapids, if not waterfalls. The snowdrifts and ice barriers were so deep, however, in most places that it was impossible to see the character of the river bed. In some stretches of the river progress was only made by climbing over one rugged hill of fallen

FIG. 11.

FIG. 12.

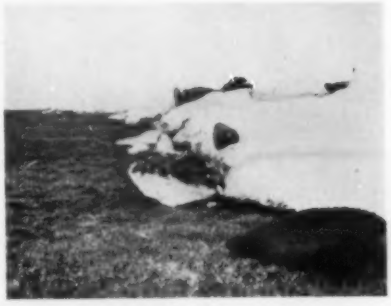


FIG. 13.

FIG. 14.

FIG. 15.

FIG. 16.

FIG. 11—Eskimo women cooking with heather on Barren Grounds in shelter of a caribou skin hung up for a windbreak. Feshing Lake, near Bernard Harbor, July 3, 1915. Fish are to be seen drying on poles laid across stones.

FIG. 12—Young man, Umingmuktogmiut, in hunting costume, with quiver on his back. Cape Barrow, May 21, 1916.

FIG. 13—Ice, boulders, gravel, and driftwood pushed up on tundra by heavy summer gale. Camden Bay, Alaska, east of Collinson Point, July 3, 1914.

FIG. 14—Cape Bathurst (Baillie Island), the most northerly trading post in Canada. July 26, 1916.

FIG. 15—Dolomite cliff, capped by diabase, Adligak Island, east of Barry Island, September 10, 1916.

FIG. 16—Cliff of diabase, overlying red quartzite, south side of Barry Island, Bathurst Inlet, September 6, 1915. There was a large glaucous gull rookery on this cliff.

snow blocks, descending twenty or thirty feet into a deep pit, and immediately ascending another ridge. It was much like working through very bad pressure-ridge sea ice. Frequently we had to boost and lift the sled up over ridges by main strength and take the dogs out of harness to let the sled down. The rock strata are horizontal in most places, with some slight local variations of not more than four or five degrees. Quartz geodes, with brown and transparent crystals of topaz, were numerous in the walls of the canyon. The tops of the surrounding hills are covered with small stones, little angular fragments of dolomite, and a few boulders of granite and diabase. The ground is barren. The only signs of life seen on the whole river trip were an Arctic fox track near Mount Davy, a few Arctic hare tracks, and one hare which we killed. One raven was seen near the mouth of the river. The coldest weather of the winter was recorded while we were up Croker River, 46° below zero Fahrenheit, at 6 A. M., March 31. The thermometer rose to 9° below zero at 4.30 P. M. the same day.

We climbed Mount Davy, the most conspicuous landmark of this whole region. Its top is about 2,000 feet above sea level, the mountain itself being only a hemispherical mound of gravel rising about 200 feet above the general level of the gradually rising coastal plain. The so-called range of mountains extending from the Melville Mountains south of Langton Bay and following the coast from Darnley Bay east seems to be entirely composed of this type of rugged drift-covered hills.

Old Beach Terraces of Amundsen Gulf and Dolphin and Union Strait

The year before, on the east side of Darnley Bay, beach gravels and terraces were found above 500 feet, and everywhere east of that point the country for some distance from the coast is of the same type. The coast has a well-defined shore line of rock or boulders and gravel. West of Chantry Island (off Bernard Harbor) there are well-preserved beach terraces up to over 45 feet above high water, and numbers of fossil shells, similar to those on the present strand line, were collected at different levels. Near the mouth of Inman River numbers of shells were collected about 170 feet above the present sea level.

The coast line from Cape Lyon eastward was found to be somewhat straighter than the former charts give it, but this difference is due to the impossibility of sketching a coast line accurately from a boat passing some distance off shore. Many of the so-called points on the map of this coast are not salient projections. The named points are more often high land or rock cliffs with low land on either side of them, giving the higher places the appearance of points or capes when viewed from a distance. The method adopted by Mr. Chipman of locating control points at frequent intervals by latitude, longitude, and azimuth observations, and traversing between these points by frequent compass sights and pacing all of the intervening shore lines will undoubtedly give a more accurate map, although the

FIG. 17.

FIG. 18.

FIG. 19.

FIG. 20.

FIG. 17—Eskimo cache at Point Wollaston, Banks Peninsula, Bathurst Inlet. Placed on pinnacle rock to protect it from predatory animals. August 29, 1916.

FIG. 18—Young man, Umingmuktogmiut, at Cape Barrow, with quiver on his back. May 21, 1916.

FIG. 19—Pillar of diabase, Barry Island, Bathurst Inlet. September 7, 1916.

FIG. 20—J. R. Cox taking time-sights at Alaska-Yukon Boundary Monument (141st meridian), August 4, 1916.

former maps of this section of the coast are really very good considering the conditions under which they were made. No serious rectification was necessary until we came to Stapylton Bay and eastward of that point.

The survey parties began work again in the Bathurst Inlet region in March, 1916, and completed their work as planned, in May. At the same time the survey of the south coast of Coronation Gulf was finished. This completed a survey of the coast from the head of Darnley Bay near Cape Parry (70° 4′ N., 123° 37′ W.) to a point well up in Bathurst Inlet, including many adjacent islands, all on the scale of ten miles to the inch. About two hundred islands were carefully surveyed in the region originally roughly charted as Lewes, Marcet, and Chapman Islands in Bathurst Inlet. These islands are steep and rocky, and they overlap in such a manner as to appear continuous when viewed from a distance.

The Bathurst Inlet Copper Area[9]

The most important result of the geological investigations by O'Neill was the detailed mapping and estimation of the available copper-bearing rock in a great new area hitherto very slightly known in the Bathurst Inlet region. Copper-bearing rocks occur on most of the islands west of a line running northwest-southeast from Lewes Island and north of Kannuyuk (meaning Copper) Island. They cover most of Banks Peninsula (Tikerayuk, the forefinger) and the western mainland shore from the mouth of Hood River to Moore Bay, extending as much as five or six miles inland from the coast. These rocks are amygdaloidal and form several successive layers which represent progressive, intermittent effusions of lava. Nearly all of these are impregnated over wide areas with native copper, occurring in veins and amygdules, and peppered through the ground mass. An estimate by O'Neill, of the copper-bearing rock, in which copper was actually seen, puts two billion tons well within the limit. As far as analyzed, the ore is of low grade, but further prospecting may locate veins and areas rich enough to render mining operations profitable. It is certainly a great reserve of copper ore. Galena was also observed, and other minerals doubtless occur. Isolated nuggets of float copper of considerable size were found; one in our collection weighed about forty pounds.

Some time in the future, possibly soon, these mineral areas will be utilized. They are remote at present and need transportation facilities, but are not much farther north than paying properties in Alaska, and in Norway, and are much farther south than the working mines of Spitzbergen. The climate is not too bad; there is a summer of about four months, and the snowfall is light in winter. Water transportation around Alaska would be rather long and uncertain, but, barring certain shoals on Bear River, there is good water transportation to the east end of Great Bear Lake, which

[9] *Summary Rept. Geol. Survey of Canada for 1916*, Ottawa, 1917.

is not far from the Coppermine area. Bathurst Inlet is a little farther, but short railroad lines could be run without serious obstacles. The winter temperature on the coast averages considerably warmer than at most points in the interior.

Ethnological Work of the Expedition: The Copper Eskimos

The ethnologist of the expedition, Mr. D. Jenness, crossed with a band of Eskimos to Victoria Island in the middle of April, as they followed the migrating caribou, and spent the whole summer and autumn of 1915 wandering alone with them after caribou and fish. The journey was somewhat unpleasant, as much of the time they were without fuel for either cooking or heating, but his experiences are interesting and he obtained a good understanding of their language, habits, folklore, and viewpoints on life in general. During the winter he supplemented this with intensive studies of the village snow-house life, and made many gramophone records of songs, shamanistic performances, and the like. Mr. Jenness was not able to return to the station until November 9, 1915, when the ice became strong enough to cross Dolphin and Union Strait to the mainland.

There is a permanently uninhabited strip of coast 300 to 400 miles long, from Cape Bathurst, the easternmost village of the so-called Western Eskimo, to Cape Bexley, the western limit of the Copper Eskimos. I shall not go into detail in describing the Copper Eskimos, since an article on that subject by Jenness has already appeared in the August number of the *Review*.[10]

While hunting caribou for clothing-skins in late summer and early autumn, the Copper Eskimos live largely on their flesh and frequently dry a quantity of meat, but this dry meat seldom does more than tide them over until the ice sealing commences. In the pursuit of the caribou they often go far inland, to Dismal Lake, Dease River, and other places too far to bring food back, as all summer inland transportation must be by back-packing, by both people and dogs.

As soon as the sea ice is frozen hard and the snow packed well enough for house-building, usually in November or early in December, all move out on the ice, build snow houses, and live until spring almost exclusively on seals, which are caught by spearing at the seals' breathing holes. The seal's flesh is eaten, and a large part of the blubber is used in stone lamps primarily for cooking, and incidentally for warming the snow houses. In spring much blubber is stored in sealskin "pokes" for fall use. Even in winter meat is usually eaten cooked.

As the sun grows warmer, snow walls, roofed with skins, are used for shelter, and during the summer the people live in caribou-skin tents, some of which are little A-shaped structures, while others are large and constructed like an Indian lodge or tepee. In summer driftwood chips are burned on

[10] *Geogr. Rev.*, Vol. 4, 1917, pp. 81-91.

the coast, while inland tiny shrubs, dwarf willow, dwarf birch, heather, or other woody plants are used, so that no difficulty is experienced in living on the Barren Grounds in that season. Fire is kindled by striking sparks from two lumps of iron pyrites, the use of flint and steel being apparently unknown. Rarely is fire produced by friction with a bow-drill.

After the seals come up on the ice in the spring—the harvest time for blubber among the Western Eskimos—the Copper Eskimos must quit sealing on the ice and come ashore. Early in the spring they fish extensively through the ice or along the shores of lakes, jigging with large hooks

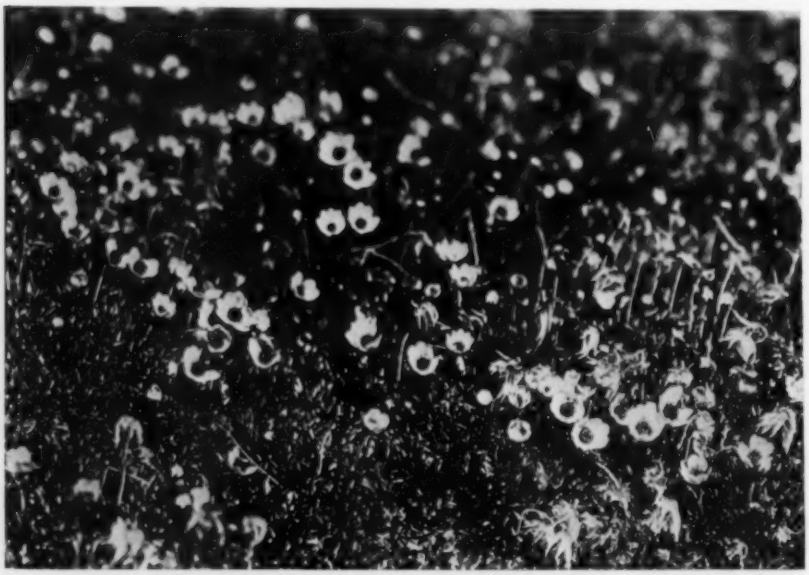


FIG. 21—*Dryas octopetala*, a common Arctic flower, with white calyx and yellow center, on Arctic coast of Dolphin and Union Strait, at Bernard Harbor. July 3, 1916.

formerly crudely hammered out of native copper. At this season they also shoot or snare a good many Arctic ground squirrels (Parry's spermophile), making use of both the flesh and the skins. Rock ptarmigan are also killed in some numbers with bows and arrows. Later, when the fish begin to run up stream from the sea, or down stream from the lakes, the Eskimos spear salmon trout in the rapids, or impound them in stone weirs. The use of fish nets was unknown to them until about five years ago, and only a very few have yet obtained nets.

Fish are abundant almost everywhere. Large salmon trout or Dolly Varden trout run up the streams in great numbers, whitefish are numerous on the coast, big lake trout in almost every fresh-water lake of any size, while tomcod or frost-fish can be jigged in great numbers at certain spots.

Northern fish as a rule are of excellent quality, since fatness and firmness of flesh are characteristic.

Their improved methods of hunting large game with modern fire-arms will be only a very slight temporary advantage to the natives, as the law of diminishing returns soon begins to operate, and undoubtedly spells extinction for some species. The depletion of the musk ox is going on rapidly. It is already practically extinct west of Tree River. The rate of slaughter of caribou is likewise increasing. The desire of the natives for white man's goods is developing, and to trap furs to satisfy these demands the people must spend more time on land. Armed with rifles, they show a tendency to follow the line of least resistance and kill whatever game happens to be easiest to secure from day to day. Consequently a great many of the Copper Eskimos, who were normally seal-hunters from December until late in May, are now coming ashore one or two months earlier than was their former custom and living on the caribou which are migrating steadily northward at that season—mostly cows going north to rear their fawns on Victoria Island.

It is a difficult matter to do much for the protection of the musk ox, as the natives of these remote regions are practically beyond the jurisdiction of game laws and regulations. But although the savages are bound to kill a certain number on their own initiative and to supply their own necessities, they should not be encouraged and abetted in the slaughter by traders who have only a temporary interest in the country and will leave the natives to their own devices again as soon as the bulk of the fur-bearing animals have been destroyed. The same may be said for the caribou. With reasonable precautions immense herds can be conserved for future use. This would seem to be much easier and more economical than first exterminating the caribou and afterwards having to introduce reindeer to feed and clothe the natives, as was done in western Alaska. The reindeer, however, have a great field of usefulness where the caribou have been killed off.

Conclusion

The Southern Party of the Canadian Arctic Expedition entered upon the summer of 1916 with most of their originally outlined work completed. Many cases of specimens in all branches of science—geology, zoölogy, botany, ethnology, archeology—all had to be packed and compressed into one small 65-foot schooner. In addition to our specimens, the boat had to carry a stock of reserve provisions large enough to see us safely out of the Arctic, and it had to take twenty-seven people to Herschel Island, including our civilized Eskimo employes and two officers of the Royal North West Mounted Police who were taking two Eskimos out for homicide, the first advent of the law into the region east of Cape Bathurst.[11]

[11] *Rept. of the North-West Mounted Police for 1916*, Ottawa, 1917.

FIG. 22.

FIG. 23.

FIG. 22—Eskimo spring dwelling. After the sun begins to melt the roofs of snow houses, the Eskimos use caribou-skin roofs supported on poles, retaining the snow walls until some time later in the season. This house is higher inside than it appears to be, because the floor is excavated a foot or two into the snowbank. Bernard Harbor, April 20, 1916.

FIG. 23—Dolomite cliffs in canyon of Croker River, eight or ten miles from mouth of the river. March 18, 1916.

FIG. 24.

FIG. 25.

FIG. 24—Castellated dolomite cliffs in canyon of Croker River, six or eight miles from mouth of the river. Expedition sled barely discernible at foot of cliff. First exploration of this river, March 18, 1916.

FIG. 25—Rough ice on Coppermine River between Melville Creek and Muskox Rapid, March 31, 1915. Ice is jammed high up on the boulder banks on both sides of river and all the way across for miles.

We were well loaded down when we left Bernard Harbor on the evening of July 13, 1916. We made a quick and easy voyage out: Baillie Island, July 24; Herschel Island, July 28; Point Barrow, August 8; and Nome, August 15. Our weather-beaten schooner was left at Nome to be sold, while men and specimens went on to Seattle and Victoria through the famous Alaska and British Columbia Inside Passage. Everything ultimately reached Ottawa safely, and the scientific men of the expedition have spent the winter of 1916-1917 working up their reports. Maps have been computed and plotted, mineral analyses made, plants and animals are being identified and new species described. Some of the collections represent specimens of groups which have never been collected anywhere in the western Arctic area, and practically all of them are from districts and localities which are unrepresented in collections anywhere and from regions never before visited by a collector.

ACROSS THE BOLIVIAN HIGHLANDS FROM COCHABAMBA TO THE CHAPARÉ

By LEO E. MILLER
American Museum of Natural History

Leaving the enterprising city of Cochabamba on the afternoon of May 9, 1915, we rode eastward fifteen miles on the first part of our journey to the Amazon Basin, arriving at the town of Sacaba by nightfall. The intervening country is thickly settled, and large areas are irrigated and planted in alfalfa, maize, wheat, grapes, and vegetables. Nearly all the inhabitants are Quechua Indians. Numerous little canals carry water from a brook along the adjacent mountain side, and the country is dotted with small stone huts surrounded by carefully cultivated fields. The rivulet never dries, but on the contrary supplies a constant stream of water of sufficient volume to irrigate a large area. The canals have been dug with great precision; each family uses only as much water as is required, and at stated intervals, so that there is enough for all. The trail goes up steadily until an elevation of 12,000 feet is reached. As we neared the summit of the ridge, a strong wind sprang up so that it was difficult to keep one's place in the saddle.

Beyond the first ridge lies the high mountain valley in which is located the Quechua village of Cuchicancha ("pig-pen"). There are several score of huts scattered about in little groups, built of stone and having thatched roofs. The Indians speak practically no Spanish and live in much the same way as they did in the days of Atahualpa. In order to cultivate the land they have gathered the stones, which everywhere cover the ground, into huge piles, and have also built fences of them; large quantities of potatoes, okas, and avas are grown. Each family owns a flock of sheep, which apparently replaces the llama of olden days, although herds of the latter animal are still frequently to be seen; they also keep a few pigs and burros and have taken to cultivating wheat, oats, and rye.

The Indians were friendly and brought us eggs, goats' milk, chickens, and bread. Each morning the children took the flocks to the narrow river bed to feed on the sparse vegetation, and at night they brought them back to the stone corrals; they carried a few boiled potatoes with them for luncheon and also their spinning for pastime. All spin except the men; and everyone had an abundance of blankets and ponchos; even the bags for grain and potatoes are made of home-spun wool. The harvest had been gathered and everyone seemed contented. One day a party of Indians collected to thresh wheat; from a distance I could hear the boom of a drum and the shrill wail of reed flutes; as I approached, a strange sight met my

eyes. Bundles of grain had been built into a high mound on the top of which sat the musicians; a dozen mounted Indians were driving a herd of mules and burros around the base. Round and round they went at a frantic pace, keeping perfect time with the music; as the animals circled the stack, a man on top cast armfuls of wheat down in their path, so that in running over it repeatedly they naturally trampled out the grain. About a hundred men, holding on to a long rope, formed a circular fence around the racing mob and prevented any of the animals from escaping. This was their method of threshing.

We were surprised at the abundance of life in this naturally barren region. There were practically no indigenous trees, but a long line of willows had been planted near one of the houses, and to these thousands of cowbirds, pigeons, and finches came every night to sleep. A short walk across the stubble fields always revealed something new. There were tinamous which rose with a loud whir that reminded one of partridges; many species of brownish birds belonging to the wood-hewer family, one of them with a long, curved bill, but running about on the ground or perched on the stone fences; large flickers lived among the rocks, and condors soared above; even flocks of gulls and plovers made this barren highland their home. The most unusual birds were two species of very small parrakeets which clambered over the rocks and slept in holes in the high banks. Vast numbers of cavies lived in the rock piles, from which they sallied at all hours of the day in quest of food; and many small rodents inhabited the grain fields.

A good trail leads eastward from Cuchicancha; the summit of the range rises about two leagues from the settlement. At the time of our visit the black, rocky peaks were covered with a mantle of snow, and an icy wind swept through the cleft which serves as a pass. The elevation of the trail is 13,400 feet. At the base of the towering masses which rise several hundred feet above the passage lies a placid little lake, and ducks and gulls were swimming on its peaceful surface. Condors swept down from above to inspect us, and then soared back to their perches among the unscalable crags. On the eastern side of the divide the trail leads downward abruptly, and the character of the country changes; at 11,000 feet a sparse growth of bushes appears, growing denser with each passing mile. Suddenly we found ourselves on the rim of a gorge through which the Incachaca River rushes—a raging mountain torrent fed by melting snows. The path was a mere shelf cut in the face of the cliff; to the left rose the smooth walls of black, frowning rock; to the right was a sheer drop to the river. We could peer over the edge of the precipice and, looking down two thousand feet, see drifting clouds that filled the chasm and shut from view the bottom hundreds of feet below.

At 7,700 feet the forest begins; a collection of half a dozen huts, called Incachaca, nestles in its inner border, and there we decided to remain for a

FIG. 1.

FIG. 2.

FIG. 1—Bringing the flocks home just before sundown, in the beautiful country near Cochabamba.
FIG. 2—Quechua Indians threshing wheat at Cuchicancha.

few weeks. We secured quarters in a large house belonging to a company engaged in digging a canal on the opposite side of the gorge; when this work is completed the water of the river will be turned into the canal and used to furnish electricity for the light and street car service of Cochabamba. A power house had been constructed at the bottom of the ravine, and cables for transmitting the current were strung across the mountains. At Incachaca the river flows through an underground channel; while exploring the forest one day we came suddenly upon a narrow cleft in the mountain side, scarcely a dozen feet across, and with a great deal of effort were finally able to distinguish the roaring, white torrent a hundred feet below. The edges of the cleft are so overgrown with ferns that one has no idea of its existence until the very brink is reached. A short distance below, the river emerges from the darkened caverns, and, plunging over the face of a precipice, thunders into a pool in a sheer drop of fifty or sixty feet.

We found the upper limit of a subtropical fauna at Incachaca. Bird flocks traveled hurriedly through the trees; they were composed of bright-colored tanagers, finches, and cotingas. Honey-creepers and hummers were plentiful in the flowering shrubs. Queer little ducks (*Merganetta*) disported in the pool below the falls, and dippers ran nimbly along the edge of the water. In one of the tall trees near the river we discovered the nest of an eagle. We found it impossible to climb the tree, but a German named Ricardo Marquardt, who was in charge of the workmen along the river, succeeded in reaching the huge mass of sticks seventy feet above the ground and brought down a beautifully spotted egg. To my companion, Mr. Howarth S. Boyle, who accompanied me on the entire trip, belongs the credit of taking the rarest birds from this locality; they were a pair of white-eared thrushes (*Entomodestes*), specimens of which, so far as I can learn, are found in only two other museums. In the lower growth lived many ant-thrushes (*Grallaria*), whose clear call could be heard at all hours of the day. This is one of the hardest of all birds to collect. The long-legged, tailless songsters never leave the thick growth of ferns and brush, and the only way to secure them is to enter the dense cover, sit quietly, and imitate the clear, ringing call in the hope of attracting one of them; sometimes this requires hours of patient work, and more often than not the effort is futile. Coatimondis, or raccoons, roamed in the woods in small bands, sniffing in the damp mould and searching for insects; while feeding they uttered deep grunts, but when frightened they gave a succession of rapid birdlike chirps. These animals spend a good deal of their time in the trees, but are almost invariably found on the ground in the day time; when pursued they are very pugnacious, and it takes an exceptionally agile dog indeed to avoid being severely torn by their sharp teeth and claws. In captivity they become very tame, although their mischievous disposition often gets them into trouble.

From Incachaca to Locotal is a distance of only eight miles; and the

scenery along a part of the route is magnificent. The bare, shattered, and split crags reach many hundred feet above the trail, and some even stand in a leaning position so that the tops actually hang over the narrow passageway as if threatening to topple down at any moment; below, the steep slope is covered with huge boulders which have fallen from the towering masses above. At Locotal there are but half a dozen houses, occupied by Quechua families who subsist mainly on the profits derived from the sale of *chicha*. We stopped a few days in a hut owned by a kind-hearted old woman who gave us permission to use it; next day we found that we were occupying the school-room, and the teacher, followed by his half dozen ragged scholars, came to take possession, but he declared a vacation until the *gringos* should move on.

The forest at Locotal is somewhat taller than at Incachaca, but the birds are of a similar character. Very abundant and beautiful were the brilliant cocks-of-the-rock; the bright, orange-red creatures flashed through the deep green of the forest like fiery comets and, perching on the low branch of a tree, quietly surveyed their surroundings or uttered hoarse, croaking calls. This bird is most conspicuous in its natural environment. Among the other large birds were green toucans (*Aulacorhynchus*), which the natives hunted on every possible occasion for the sake of obtaining the bill. This they use as *remedio,* the rasping sound made by rubbing the mandibles together being supposed to be a sure cure for epilepsy.

While we were pursuing our work at Locotal, a man named Quiroga chanced to pass and begged that we pay him the honor of stopping at his house some distance below; it was a charming place, he said, in the very heart of the wonderful *yungas*. We gladly accepted his invitation and one morning loaded our outfit on mules and started down the trail. For a mile there is only a narrow ledge in the face of a rounded mountain of dark sandstone; a few stunted sprouts and myriads of orchids covered with purple blooms have secured a precarious foothold in crevices in the glazed surface; hundreds of feet below, but invisible, the river tears through a narrow gorge.

Miguelito is only three miles below Locotal and consists of three or four huts in the center of a grassy clearing. The Quechuas who live there are friendly, and one may be sure of a welcome for a night's stop. At 5,500 feet the forest becomes taller and the trees attain a greater diameter. The vegetation of the subtropic zone reaches its highest development at this altitude. After crossing a ridge 6,700 feet high, the trail descends a long slope into the *yungas,* properly known as the *yungas* of Cochabamba. At the base of the ridge, and shortly before entering the cultivated area, we crossed the dry, narrow bed of a stream which was filled with rocks bearing the imprints of leaves, and also fossil shells.

Yungas is the name given to the fertile mountain slopes which have been cleared of forest and cultivated. When we visited the region, in June, only

FIG. 3—Pass at Cuchicancha.

FIG. 4—Tightening the packs at the base of the pass, beyond Cuchicancha.

the Indian caretakers lived in the habitations, the coca, which is the principal product, having been collected a short time before and the *proprietarios* having gone back to Cochabamba. The owners visit their plantations three times a year, supervise the gathering and packing of the leaves and, after a month, return to Cochabamba to sell the drug and live on the proceeds until the next harvest.

After spending an hour in questioning the occupants of the various houses that we passed, we succeeded in locating the hut to which we had been invited. It was a low, one-room, board structure, open at both ends and having wide entrances on each side, situated in the center of a large banana field. An Indian, so old that he could hardly walk, lived in the hovel and refused to admit us; however, we flourished our letter of introduction from the owner of the premises, took possession without very much trouble, and remained a week. The climate at this season, June, is most trying. Although the elevation is only 3,500 feet, the whole region was covered with fog every night, and the cold and damp penetrated everything; during a part of the year the weather is good, and then life in the *yungas* is more tolerable.

The fauna of the country seems to represent a transition zone. There are birds typical of the higher country, and others which are common lower down; also, a number found at approximately this altitude only. Near the house, and on the edge of the banana plantation, was a tall, isolated tree. Flocks of birds in their flight from one side of the canyon to the other would invariably alight in its branches for a few minutes. There were many brilliantly colored little tanagers (*Tanagra*) which came to the tree in considerable numbers and chirped and quarreled as they flitted about examining the leaves for insects, or reached out to pick the small fruits with which the tree was covered; one day not less than seven species of these birds visited this resort within a short time. Giant orioles (*Ostinops*) were also very plentiful, and traveled in large, noisy flocks. One of the more interesting birds was a species of small, red-tailed parrakeet (*Pyrrhura*) which clung to and crawled up the sides of trees like woodhewers; it was almost impossible to see them unless they moved, so well did their coloration conceal them.

There is no flat valley along the river, which is of considerable size, and all cultivation is done on the steep mountain sides. Coca is planted in terraces and occupies the greatest acreage; there are also red bananas, plantains, guavas, and sugar cane. Numerous huts of flimsy construction are scattered along the entire twenty miles or more of cultivated slopes; each has a fenced-in area paved with flat stones upon which coca leaves are dried. We stopped at a number of these dwellings in an attempt to buy fruit or vegetables, but unfortunately the men were all away working in the fields, and anyone who has attempted to purchase anything from the average Quechua squaw knows how hopeless a task it is. Although they may have a super-

abundance of the article desired, they seem to take great delight in refusing to sell anything to a stranger. In such cases the only method to follow is to take what is needed, pay a fair price for it, and pass on, leaving them in the midst of their wild rantings. The men are easier to deal with. The peons, and the patron as well, stopped at each hut where the white flag announced that *chicha* was for sale, and attempted to drink enough to last them until the return; after their money gave out they left articles of clothing in payment for the drinks. It was therefore a great relief when the last abode of the intoxicating beverage had been left behind, and we plunged into the wilder-

FIG. 5—Town and valley of Cuchicancha in the Eastern Andes of Bolivia.

ness. Immediately after leaving the *yungas* we ascended a precipitous slope, the top of which was 700 feet above the surrounding country; and then descended on the other side until the elevation was only 2,000 feet; here the forest was more tropical in character, and some of the trees, especially the cottonwoods, reached a height of 150 feet and measured 25 feet through the buttressed roots at the base.

The day after leaving the *yungas* we reached the most dangerous part of the whole trail. After crossing a number of steep, high ridges, we came to an abrupt slope seared by a huge gash where the treacherous white clay slides constantly into the river, many hundreds of feet below. Each caravan desiring to pass must first cut a ledge in the moving mass of soft, muddy earth, and then hurriedly lead the mules across, one at a time, before

the newly-made trail is obliterated. The spot is very appropriately named *Sal si Puedes* (pass if you can).

That night we made camp early on the banks of the Rio San Antonio, called "Chuspipascana" by the Indians, which means Mosquito River. The altitude of the site is only 1,800 feet above sea level. The river was a clear, rapid stream one hundred feet wide, flowing through a rock bed a quarter of a mile across. Swarms of black flies, sand-flies, and other stinging or biting insects immediately came out to greet us. Birds were very abundant. In addition to the jays, ant-wrens, and manakins which remained in the forest, flocks of parrots and toucans flew across the open spaces. An unusual occurrence was the great flocks of a new species of giant oriole; there were not less than a thousand of these birds in a single flock, and they roamed almost everywhere, coming close to camp to inspect the tents and to discuss them in hoarse cries of curiosity or resentment. They were beautiful creatures, of a deep chestnut color with light olive-green head and neck; the face is devoid of plumage and is flesh-colored, while the tip of the bill is deep orange. The flesh is highly esteemed by the natives. As soon as the cargoes were neatly placed in a pile and covered with a tarpaulin to keep them dry, the peons cooked their supper; this consisted of a thick soup made of corn meal and *charque* (dried beef). They had a meal in the morning and another at night; during the long walk throughout the day they chewed coca leaves. The mules were turned loose to shift for themselves, but, as plenty of wild cane grows near the rivers, they had an abundance of food.

The remainder of the journey was through the heavily forested lowland; the last of the mountain ridges had been left behind. During the dry season caravans follow the courses of streams as much as possible. The water is low and the wide, rocky margins serve as roads. This is far from being easy on the mules; the animals go stumbling and slipping along, but a good many miles are cut from the total length of the journey. Streams are encountered with frequency and as one penetrates farther into the interior they become wider and deeper. We crossed not less than six fords in a single day, all between two hundred and three hundred feet wide, the water averaging from three to four feet deep. Although the current is strong, the mules are accustomed to this kind of work and usually manage to cross safely, often stopping unconcernedly in the deepest, swiftest spot to take a drink. Occasionally, however, one of the animals slips on a moss-covered boulder and falls; then it is a difficult matter to assist the drowning creature to his feet, as the swift water may roll him over and the weight of the pack keep him down.

Wild animals are particularly abundant in this section of the country. All day long we could hear the raucous scream of long-tailed, multi-colored macaws (*Ara*) as they flew two by two overhead. Many hawks sat alert on dead snags near the water, and black and white gulls flapped silently

up and down the river. Occasionally we caught a glimpse of a small flock of muscovies, the largest of South American ducks, as the great, black birds flew heavily upstream. There were also guans, resembling small turkeys, which sat quietly in the tops of tall trees until we approached quite near to them; then, emitting a loud, mulelike bray, they set their wings and soared across the river or down into the underbrush. At night the forest was usually quiet, reminding one of "Pools of Silence." Occasionally, however, the still air was suddenly rent by the most unearthly noise that mortal man ever heard, and the woods rang with the wild, insane cackle of forest rails (*Aramides*). Beginning with a shrill *oohoo-hee-era* the demoniacal chorus would continue several minutes without interruption, finally ending with a few low, explosive *cow-cow-cows*. A number of birds always sang together, and the first time one hears the performance it is enough to make the flesh creep and the hair stand on end; and even after one becomes somewhat accustomed to the noise it fails to be conducive to peaceful slumber. Night monkeys (*Douroucouli*) were apparently plentiful, but we never saw them in the daytime. After darkness had fallen they began to move about in the tree-tops; on one occasion a troop selected the tree under which we camped for the scene of their frolic, and kept us awake the greater part of the night. They dropped leaves and twigs down upon the tent-fly, probably through accident, but perhaps prompted by the desire to find out if anything would happen. At frequent intervals they drew together in a close group to chatter in low, grunting tones, and then, apparently coming to the conclusion that the queer-looking objects below them must be capable of some interesting action, again tempted fate by showering down more twigs and leaves.

In many places the receding water of the river had left isolated pools; these were teeming with fish of many species, some of which were of large size; a number we caught had practically the entire tails and fins eaten off, their cannibalistic brethren having no doubt taken advantage of the circumstances and begun to devour them piecemeal at their leisure. The trees were tall and straight, and there was dense undergrowth near the rivers only. Mosses and epiphytes, so typical of the subtropical zone, were almost lacking; but frequently the wind brought the delightful fragrance of ripening vanilla beans and the perfume of flowers. Great clusters of scarlet trumpet-flowers dangled from the tips of slender vines, and from the tops of many of the trees drooped long garlands of huge white and blue flowers that resembled sweet peas; some of these blooms were two inches in diameter. There were also clumps of terrestrial orchids on some of the rocks, with slender spikes of deep purple flowers waving daintily under the impulse of each passing breeze.

Seven days after leaving Cochabamba, we came suddenly upon the little cluster of grass and bamboo houses known as Todos Santos; there were exactly eight of them, two of which were of large size, partially enclosing

a wide plot of ground carpeted with soft, green grass; tall forest hemmed in the settlement on three sides, and the Rio Chaparé, flowing through deep banks, formed the boundary on the fourth side. The largest building was occupied by the *intendente,* or Federal agent, who generously provided us with accommodations; in addition to the several living rooms, there was an immense ware-room stored with hides, salt, and other articles of commerce. The other houses were occupied by families of Bolivians who

FIG. 6.

FIG. 7.

FIG. 6—The moss-draped forest of the subtropical zone in the *yungas* of Cochabamba.
FIG. 7—Quechua hut in the *yungas.*

possessed land or concessions in the neighborhood and owned numbers of Indians of the Yuracaré tribe; these latter lived in long sheds built in the rear of the dwellings of the people they served. There was also a small church, but no shops of any description. In spite of its inconsiderable size, Todos Santos is a place of importance because it serves as an outlet for commerce from Cochabamba, and Bolivia in general, and is the port of entrance for hides from Trinidad, and merchandise entering by way of the Amazon and Madeira-Mamoré Railroad. A small steamer, the *Ana Katarina,* was tied up against the bank waiting for the water to rise sufficiently for her to proceed down the river; this boat plies more or less regularly between Todos Santos and Trinidad, and requires three days for the downward trip, and five days coming up. From Cochabamba to Trinidad is a distance of approximately 265 miles, 165 overland, and an additional 100

on the river. During the dry season, steam navigation on the Chaparé is very irregular, but canoes of large size and native paddlers may always be had. During the rainy season there is a small steamer or launch every fortnight.

Several years before, the Government had, by law, abolished the practice of keeping Indians in a condition of semi-slavery and had ordered all owners to turn them over to the missions; this, however, had not been done,

FIG. 8.

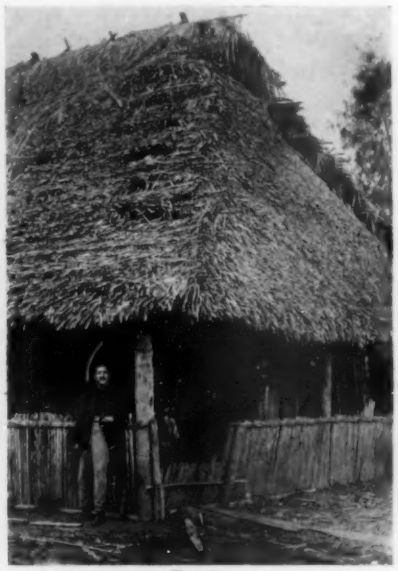


FIG. 9.

FIG. 8—A crude shelter of stones and brush erected by Quechua Indians in a river bed. A white flag waving overhead announces that *chicha*, an intoxicating beverage, is for sale within.

FIG. 9—The principal building in Todos Santos.

and each Bolivian family living at Todos Santos had a number of Yuracarés in its service. Not far from the settlement were a number of clearings, some of considerable size, where fruits and vegetables were cultivated for the benefit of the *amos*, as the owners of Indians are called; the Indians cleared the ground, cultivated it, and then brought in the results of their labor, receiving nothing in return. They seemed fairly contented, however, and did not appear to be suffering from ill-treatment. They frequently spent days at a time in their shelters on the edges of the fields, or on hunting and fishing trips far from their homes.

Every Yuracaré woman kept a number of Amazon parrots which she looked after carefully and refused to sell, even at a good price. Upon asking the reason for this I was told that they rear them for the sake of the tail-

feathers, which are in great demand by the Aymarás. A parrot will grow three crops of feathers a year, each of which is worth fifty *centavos*. The Aymarás from the vicinity of La Paz send down agents at regular intervals to purchase these feathers, as they use them in making ornaments worn during their annual festivals. In the branches of one of the tall trees near the village a neat little hut, resembling a Philippine tree-dwelling, had been built of bamboo and leaves. Indians armed with bows and arrows concealed themselves in this house, forty feet above the ground, and shot many of the birds which came to feed on the growing fruit; other Indians, hidden about the base of the tree, watched the birds as they fell, gathered them up, and skinned or plucked them. In this way quite a number could be shot without alarming a feeding flock.

The forest around Todos Santos abounds in wild life. Squirrel-monkeys (*Saimiri*) are very numerous and travel in troops of from twenty to fifty individuals; we saw them daily, playing in the trees, and feeding on fruits, buds, and insects. They are delightful little pets, and one that we owned spent the greater part of the day catching the mosquitoes which infested our habitation. It searched every nook and crevice for insects, and one of its chief pastimes was to look through a pack of cards in the hope of finding mosquitoes between them. Harpy-eagles also are very plentiful and feed on the squirrel-monkeys to a great extent, as they are easy to catch. However, monkeys are not the only animals which suffer; we one day found the remains of a sloth that had been dropped by an eagle; the entire forepart had been eaten away.

There were numerous trees covered with vivid, scarlet blossoms, scattered throughout the forest and forming gaudy little islands of color which stood out very conspicuously amid the green tree-tops. These trees are known as *madre de cacao* because they are frequently planted in cacao groves to shield the young plants from the sun. The flowers contain so much nectar that numbers of birds feed upon them, including parrots, macaws, and orioles; when the brilliant blooms fall into the river they are greedily snapped up by fish.

Of small birds there was such a variety that it would be impossible to mention all of them; but one in particular deserves attention: it is a species of manakin called "child of the sun" by the Yuracarés, who look upon the tiny creature with reverence and do not harm it under any circumstances. The bird is not as large as a sparrow, but is of stocky build, with a bright orange-red head and neck, the remainder of the body being black. As it whirs from branch to branch it makes a loud sputtering, crackling noise which reminds one of a bunch of small, exploding fire-crackers. The female of the species is of a dull green color.

At Todos Santos, as elsewhere, local migrations of birds in the heart of the tropics were several times forcibly brought to our attention. We had been hunting in the forest a number of weeks and were pretty well

acquainted with its inhabitants; suddenly a species entirely new to us appeared in great abundance in all parts of the region; each member of the expedition, including the native assistants, brought in specimens of it the same day. This can be explained only by the fact that flocks of these particular birds had arrived suddenly from some distant part, probably attracted by a fruit or insect which chanced to be plentiful at the time, and upon which they fed.

Several miles from port and entirely concealed by the forest, stretches a lagoon of considerable size; it is connected with the Chaparé by a small, brush-clogged creek, but the water is stagnant and filled with decaying vegetation and detritus. Masses of bushes and swamp grass grow all along the borders, and in some sections the surface of the water is covered with floating, aquatic plants. As may be supposed, many species of birds live both about the water and in the dense thickets that line the banks. Among the former was the rare little sun grebe, but it was by no means abundant; the few solitary individuals we saw were always surprised out in the open water, and, after giving a series of hoarse, loud cries either flew or swam as rapidly as possible to the nearest clump of vegetation that offered a secure retreat. Graceful jacanas stepped about daintily on the lily-pads; their toes are very long and give the feet a wide spread, thus enabling the birds to walk on the floating little islands of water hyacinths and wild lettuce; for this reason the natives call them *pájaros de Jesú Cristo*, because they can walk on the water. Several species of flycatchers and large, noisy wrens (*Donacobia*) lived in the partly submerged bushes; we found several of the bulky, domed grass nests of the former, but it was almost invariably impossible to reach them, as they always harbored colonies of biting ants which rushed out in maddened frenzy when the nest was touched; however, the birds and ants seemed to live in perfect harmony. In the tangles of tall bamboo growing on the bank and drooping out over the water, lived flocks of hoatzins, and numbers of several species of dendrocolaptine birds or wood-hewers; also an occasional water turkey and cormorant. Many black and white ibises soared above in circles and at a great height; they acted not unlike vultures, but the long, outstretched neck and legs immediately gave a clue to their identity.

The forest was full of surprises; one morning my companion encountered a tamandua ant-eater which was on the ground and refused to realize that the close proximity of man meant danger; my companion was but lightly armed and shot the tough, thick-skinned animal with the 32-bore auxiliary tube of his shot-gun and number 12 shot—an unheard-of feat. It was, however, not always necessary to go into the forest to hunt; the open plot in which the settlement lay attracted many birds, such as tanagers, vermilion flycatchers, swallows, and others, which were never found in the forest; and small mammals in abundance lived in the houses. We frequently caught five species of rats in a single house in one night, and

at least two species of bats lived in the palm-leaf thatch of the roof. Some of the rodents, particularly a large spiny rat, lived under the floor, while others made the walls and ceiling their homes; each species seemed to adhere more or less closely to its own part of the dwelling, thus dividing the houses into well-defined "life zones." The natives are very fond of the flesh of the spiny rat and often begged for any which chanced to come to our traps. Ocelots were not wanting in the neighborhood; they visited the hen-houses occasionally at night, but never entered by the doors, preferring to tear holes in the side of the structures; they killed a large number of fowls, on one occasion nearly twenty on a single visit, prompted apparently by the mere lust for killing.

At night vampire bats came out in hordes; they attacked everything from human beings down; even the few miserable pigs kept by the Indians were severely bitten and kept up a continuous squealing as the bloodthirsty creatures settled on them, usually at the base of the ears, and began their painful operations. The worst sufferers by far, however, were the mules. As soon as the sun set, our peons brought the animals to the corral and strapped canvas covers over them; this precaution, however, was of little avail, for the bats attacked all exposed parts, causing the mules to kick and roll with the result that their covers were soon torn off. We went out frequently to watch these obnoxious creatures at work; after circling above their prospective victim a few times, they dropped suddenly, usually upon the neck or flanks, and at once began to bite and suck, making a grating sound with the teeth all the while. They paid no attention to us, although we stood but a few feet away, but clung with folded wings to their victim, perfectly motionless and in an upright position; if we moved they uttered a few squeaks, but made no attempt to fly until we reached for them and came to within a few inches, when they reluctantly fluttered up but almost immediately settled on the other side of the animal. Desiring specimens of them for our collection, we went one night to the corral armed with a butterfly net and, approaching one of the mules on whose back were a dozen or more bats, made a hurried sweep with the net; as the large, white bag of netting scraped the back of the nervous animal he sank to his knees with a groan of despair, wondering, no doubt, what new monster had swooped down upon him to add fresh suffering to his already unbearable existence. In the morning the mules were in a pathetic condition; blood continued to flow from the wounds made by the bats' sharp teeth, so that the ground was red, and the animals were covered from head to foot. It was always necessary to take them to the river and wash them, and then disinfect the numerous punctures; if this is not done flies attack the sore spots, infesting them with their larvae, and the animals die of blood-poisoning. After three nights we were compelled to start the mules back to Cochabamba, as they were on the verge of exhaustion.

While at Todos Santos we learned of a mission among the Yuracaré

Indians, about twelve miles distant, near the Rio Chimoré. We expressed a desire to visit it, but the *intendente* told us that such a move was impossible. He said that the priest in charge of the mission was absolute monarch of the territory under his control; that he would permit no one to come near his retreat; and that this mandate had never been disobeyed. Such statements made the place seem all the more alluring, and we were eager to go there at almost any cost; we devised many plans which we hoped would lead to an interview with the priest, but all of them failed miserably; finally, however, the opportunity came to us in an unlooked-for manner. A misfortune to one person frequently comes in the guise of a blessing to another, and so it happened in this instance. As we were pursuing our work one afternoon in the open corridor in front of our room, a long canoe drew up at the river bank and a priest, followed by a dozen Indians, stepped ashore and marched across the clearing to the *intendente's* quarters. We immediately recognized him as Padre Fulgencio, the missionary of whose despotic rule we had heard so much; but he did not even glance at us as he passed. While we were debating upon some diplomatic move which might serve as an excuse for an interview—for now or never was the time to obtain the coveted permission—he suddenly emerged from the house and came straight to us. A few curt remarks were exchanged and then he related his trouble. To make a long story short, he was suffering from a severe toothache; it had kept him awake many nights, and at last he was forced to come out of his retreat in search of a remedy. The *intendente* could do nothing for him; could we do anything?

How I thanked my lucky star for a limited knowledge of medicine! After an examination, conducted with much formality, the trouble was pronounced curable. He submitted bravely to the injection of cocaine, and soon after was relieved of the aching member. Tears rolled down his cheeks as he expressed his gratitude, and then, taking note of the work upon which we were engaged, he suddenly asked: "Why don't you come to the mission? I have four hundred Indians who spend several days each week in hunting; they can take you anywhere and also bring you all kinds of animals." We needed no urging, and within five minutes the day was set when porters in abundance would come to convey our equipment, and we should start on our journey to the mysterious stronghold of Padre Fulgencio and the boundless jungles bordering the Rio Chimoré.

WESTERN CANADA AND THE PACIFIC

By WALTER S. TOWER
University of Chicago

Two rival Canadian ports on the Pacific coast are of special interest at this time in view of the prospective opening of a Hudson Bay route to Europe for western Canada's wheat fields and the strong leveling tendencies in cereal distribution that have their origin in the war. Vancouver is an established port, having all the strength that grows out of a fixed place in the commercial scheme. Its competitor, Prince Rupert, 400 miles north, is new and untried. It hopes to become a Pacific emporium and to rival not only Vancouver but the cities of eastern Canada. It is already the terminus of the Grand Trunk Pacific Railway. What are its tributary economic areas? In the commercial race that goes hand in hand with the swift agricultural development of the Canadian prairies, what are its prospects of success? To answer these questions one must look not only at the resources of the regions that feed these two outlets but also at the principles of port development that apply the world over.

The advance of farming across the Canadian prairies has been marked by the steady northward extension of the zone of active development, largely because of better climatic conditions in the north for the production of the chief commercial crops—wheat, oats, and flaxseed. Central Saskatchewan and the region westward to Edmonton, Alberta, quickly led in the heavy production of cereals. These newer farming localities lie to the north of the line of direct communication with the original Pacific outlet at Vancouver and occupy such positions with reference to other parts of the Pacific coast as to lead naturally to the consideration of building new railroads to new ports on the western ocean.

There are at least four large factors which obviously would influence the selection of routes to the Pacific from the Canadian prairies. In the first place, the distance to which the cultivated area is extended northward largely determines the practicability (or economy) of shipping by the original route (Canadian Pacific) to Vancouver. From the region of Edmonton, via Calgary, to Vancouver it is 100 miles farther and much more difficult (Fig. 5) than to more northerly Pacific points, as Prince Rupert. In the second place, the location of passes across the Canadian Rocky Mountains and of natural routes through the rugged belt to the west largely determines the feasibility of building new trans-Cordilleran railroads to connect the farming communities and the Pacific coast. There are a number of good passes across the main mountain ranges between the 49th and the 60th parallels, which represent the approximate limits of the possible

wheat-producing area. Some of these passes, however, are of little or no use to the region, because of unfavorable location with respect to producing centers or to trans-Cordilleran routes (Howse Pass; Fig. 1). Satisfactory routes through the belt of rugged highland four hundred miles wide must be sought along valleys, preferably those which extend all the way from the Rocky Mountains to the Pacific coast or, if necessary, along low-gradient valleys which head near each other on a low intervening divide (Fig. 1).

A third factor, equal in importance to either of the others, is the character and location of harbors, or sites for commercial ports, to be reached by these routes. British Columbia has a typically fiorded coast, which means

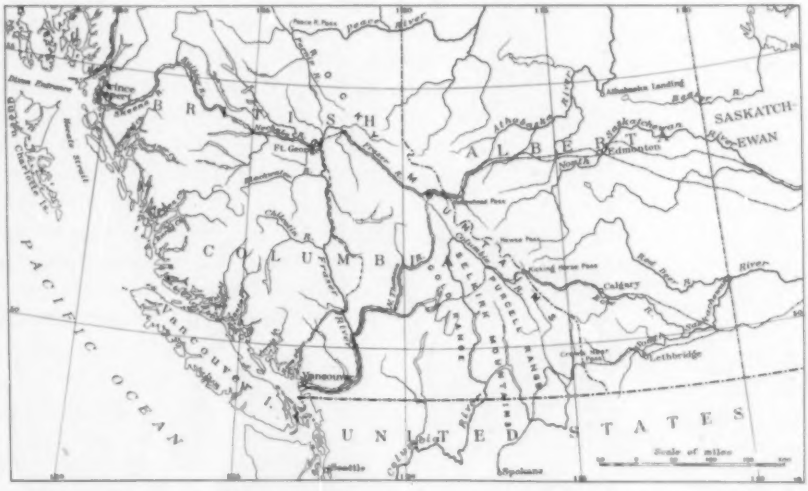


Fig. 1—Sketch-map showing rivers and routes of western Canada. Scale, 1:15,000,000. *Note:* For "Parnip R." (56° N.) read Parsnip R.

there are many deep, well-sheltered indentations (Fig. 1), more in fact than possibly could be utilized as harbors in the development of commercial centers for Pacific Canada. For various reasons, however, many of these indentations are unsuitable for port developments, as is illustrated by the typical case of Bute Inlet (Fig. 2). In some the water is too deep to provide good anchorages; some have such narrow, winding entrances as to make the passage of vessels difficult or unsafe; a majority are bordered by land too precipitous, or too rugged, to permit satisfactory development of an important commercial city; and nearly all of them are difficult to reach from the interior. To these general objections, applying in one way or another to almost all the indentations, there must be added the fact that nearly half the mainland coast of British Columbia lies back of Vancouver Island (Fig. 1), which means that, except for the indentations near the northern and the southern ends of the island, a serious handicap is imposed

by the long and roundabout route necessary to reach these harbors, which lie shut off from the open ocean by the island barrier. Finally, the natural resources and economic prospects of the country to be traversed would vitally affect profitable railroad development, and so influence the choice of routes.

Of the four enumerated factors apparently the greatest is the character and location of the valleys. Outside the routes made possible by the chief valleys, the high altitudes and extreme ruggedness would involve steep grades, high costs of construction and of operation, and other handicaps serious enough, presumably, to prevent any attempts to build trans-Cordilleran lines. Excluding valleys in British Columbia that lead into the United States or the territory of Alaska, the zone of possible port development is narrowed to the strip between latitude 49° and latitude 54° 40′, or a straight-line distance of only 400 miles. Within these limits, there are numerous streams entering the Pacific, each one of which has fiorded sections close to its mouth and potential harborage; but most of these streams rise in, or on the Pacific side of, the Coast Range and do not provide outlets for trans-Cordilleran routes (Fig. 1). Only two of the rivers, the Fraser and the Skeena, receive tributaries which rise very far to the east of the Coast Range, and thus their valleys are the only ones which provide large gaps in the great topographic barrier of coastal British Columbia.

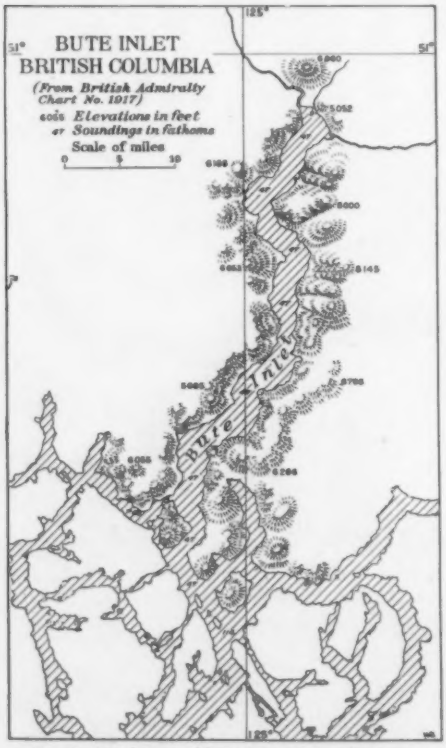


FIG. 2—Sketch-map of Bute Inlet, useless for commercial purposes. Scale, 1:1,000,000.

The Fraser has a system of three important tributary lines, one from the east, one from the northeast, and one from the north (Fig. 1), or, as they may be named according to tributary waters, the South Thompson-Fraser, the North Thompson-Fraser, and the main Fraser routes, uniting in the lower valley which comes out to the Pacific nearly opposite the southern end of Vancouver Island. These three tributary valleys, furthermore, head toward the eastern edge of the Cordilleran belt and not far from good passes

over the Rocky Mountain barrier. The Skeena, on the other hand, has a much smaller system, enters the ocean close to the Alaskan boundary, and has only two tributary lines, one from the north and one from the east, the main Skeena and the Bulkley. Neither of these valleys heads close to the Rocky Mountains, but both must be approached from the east through the valleys occupied by the upper waters of Fraser or Peace River tributaries (as the Nechako and Oslinka).

In the four hundred miles between the Fraser and the Skeena, several rivers enter the conspicuous "channels" or "inlets," as they are there

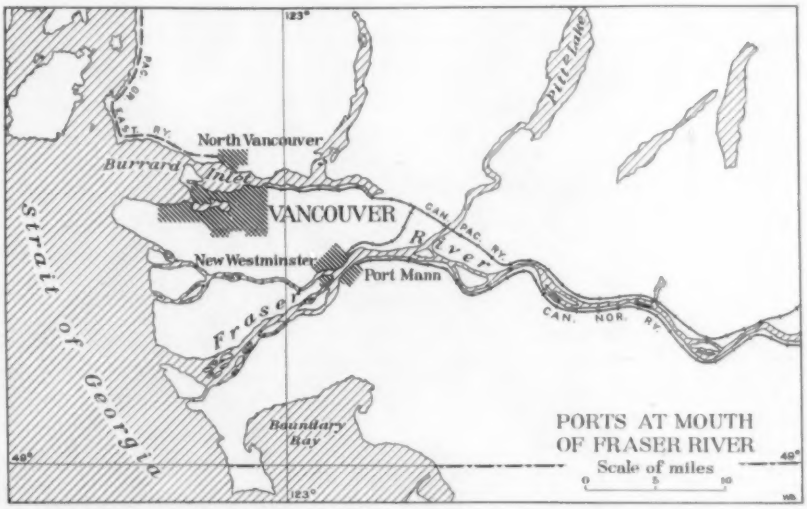


FIG. 3—Sketch-map showing the ports near the mouth of the Fraser River. Scale, 1:800,000.

called, but they are of no commercial value. Nothing would be gained, for example, by seeking outlets from the Fraser River basin, in central British Columbia, over the divide of the Coast Range, into such valleys as those which lead to Knight, Bute, Toba, and Jervis Inlets (Fig. 1). The two rivers entering Douglas Channel and Gardner Channel north of Vancouver Island are only a hundred miles from the mouth of the Skeena. They are comparatively short streams, heading on the western slope of the Coast Range. The only other ones which are worth mentioning head east of the Coast Range: the Salmon River flowing to Dean Channel, and Bella Coola River to Burke Channel (Fig. 1). Between their headwaters and the tributaries (Blackwater and Chilcotin) of the Fraser system, however, there is the obstruction of a comparatively broad and high divide. Further, the route from prairie points via one of these valleys to the coast would be very devious, and the coastal topography is prohibitively rugged (Fig. 2).

There is not much difference in the quality of the harbors of Vancouver

and Prince Rupert;[1] each harbor is large enough and deep enough to accommodate all the shipping that it may be called upon to receive. They are admirably protected by lines of sheltering islands and prominent headlands (Figs. 3 and 4). Both have long usable water frontage, offering almost unlimited possibilities for wharf and dock development. Both have adjacent sites suitable for the development of cities of large proportions. The moderately hilly character of the land about the harbors makes town sites unusually attractive both from the standpoint of scenery and that of public health. The only notable difference between the harbors is in the character of the entrances. Vancouver lies some distance north of the southern end of Vancouver Island, which necessitates a voyage of approximately 200 miles, through the Strait of Juan de Fuca and the Strait of Georgia (Fig. 1), where, in foggy or stormy weather, the problem of navigation may be difficult. Prince Rupert, on the other hand, through Dixon Entrance to the west or the broad Hecate Strait to the south (Fig. 1), has a wider, more direct, and somewhat shorter entrance from the Pacific. However, this advantage is probably altogether too small notably to affect the development of Prince Rupert.

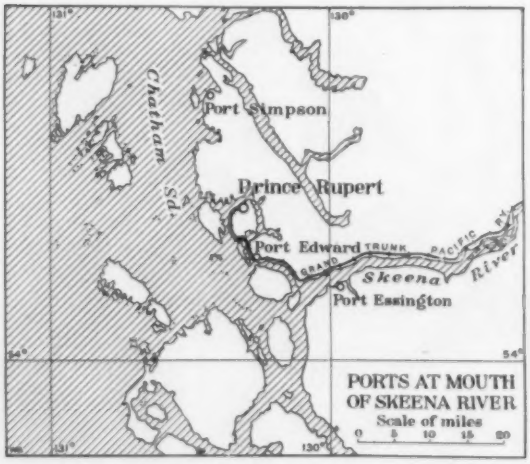


FIG. 4—Sketch-map showing the ports near the mouth of the Skeena River. Scale, 1:1,500,000.

What is the character of the land adjacent to the two localities? Within a radius of a hundred and fifty miles from either port the land is rugged, heavily forested, with small agricultural possibilities, and for the most part not known to be especially rich in mineral resources. There is more cultivable land near the lower Fraser valley and on Vancouver Island, however, than there is near the lower Skeena valley and on the Queen Charlotte Islands, for it might almost be said that good agricultural land of any considerable extent does not exist within a hundred and fifty miles of Prince Rupert. There is also a difference in the character of the forests. Along the southern part of the British Columbia coast is found one of the most valuable commercial forests of fir, hemlock, and cedar in North America.

[1] Except for harbor conditions the factors affecting Vancouver may be said to cover the other towns of that district, including New Westminster, North Vancouver, and Port Mann; while Prince Rupert likewise covers the case for Port Edward, Port Essington, and Port Simpson (Figs. 3 and 4).

In the vicinity of Prince Rupert, on the other hand, where conditions (of climate especially) are less favorable, the trees are smaller, the stand is not so heavy, and there is a predominance of the less valuable kinds, like hemlock and spruce.

The Vancouver region appears in the present state of information to be superior in mineral resources. At all events, there is little reason to suppose that the productive coal fields of Vancouver Island are equaled by deposits in the lower Skeena basin.

Prince Rupert is nearer to Alaska; it is nearer to Oriental ports as far south as Shanghai; and it is the Pacific terminus of the shortest route (now and probably for the future) between eastern Canadian (or western European) localities and those Oriental centers north of Shanghai. Vancouver, on the other hand, is nearer to the United States, to the Panama Canal, to all points reached by way of the canal, and to places in the Orient south of Shanghai. The sailing and steamship routes most frequented in the Pacific lie mainly far to the south of Prince Rupert. Hence existing trade relations for the Pacific seem unlikely to lead to the passage of shipping close enough to Prince Rupert to make that place a convenient port of call. Shipping between Alaskan and southern ports, relatively unimportant, is the only exception to this condition. Vancouver, on the contrary, is much more favorably located with reference to the long-established (and probable future) shipping routes in the North Pacific, largely as a result of its proximity to the important Pacific ports of the United States.

The relative merits of the routes inland from Vancouver and Prince Rupert must be determined largely on the basis of (1) distances between the ports and their respective productive areas, (2) the potential resources of the Cordilleran section through which the lines run, and (3) the extent and character of the entire region from which traffic can be drawn. It may be noted, first, that a radius of 500 miles (air-line distance is in this case comparable to road mileage) from Vancouver as a center, includes all the Cordilleran (British Columbia) region south of latitude 56°, and the western margin of the prairies from the Peace River country on the north to the plains of southern Alberta, over a width ranging from a hundred to two hundred miles east of the Rocky Mountain axis. A similar radius from Prince Rupert as a center includes the greater part of central and southwestern British Columbia, but only a relatively small strip of the prairies, mainly in the Peace River country and to the north. The area lying exclusively within the Prince Rupert radius, in north-central British Columbia and the northern prairies is less valuable economically than the areas lying exclusively in the Vancouver radius in southern British Columbia and the southern prairies. So far as mileage of land haul is a factor, Vancouver seems to have a substantial advantage in being nearer to large regions with good prospects.

The economic possibilities of the country traversed by railway lines in

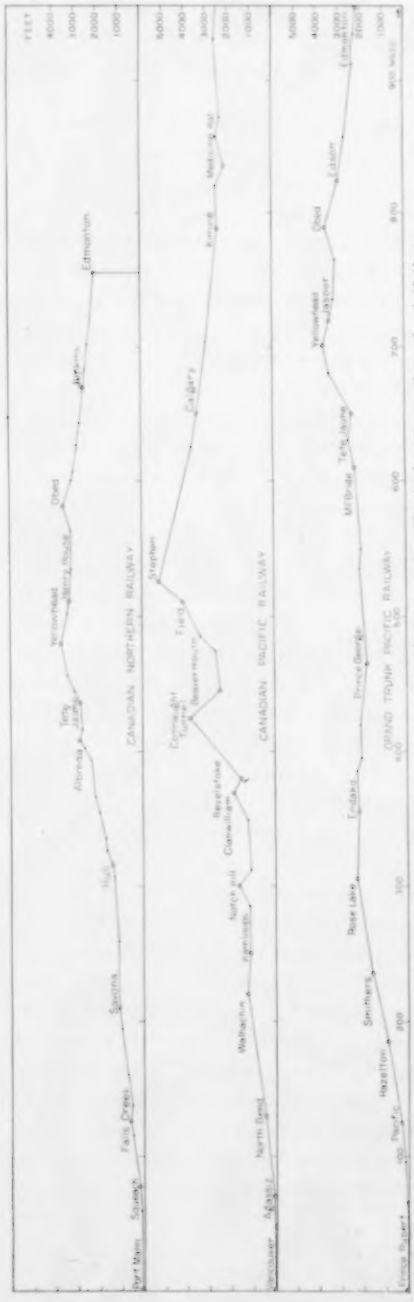


Fig. 5—Profiles of the three trans-Cordilleran railroads in Canada. Vertical exaggeration, about 85 times.

the Fraser basin are largely superior to those touched by railroads through the Skeena basin. Agricultural opportunities are just as good, if not better; forest resources are conspicuously greater; and mineral deposits, so far as is known, are much richer in and near the southern valleys than in those to the north. Thus, within the area naturally to be tapped by way of the Fraser routes, lie nearly all the important mineral-producing regions in the mainland of British Columbia. As a source of local traffic and an aid to profitable operation, therefore, the valleys of the Fraser system are the best for railroad routes between the prairies and the coast.

The extent of the region from which traffic logically may be drawn can hardly be marked out with rigid limits, but it must consist largely of British Columbia and the prairies east as far as the mountains about central Saskatchewan. East of Saskatchewan and perhaps in the eastern half of that province, there probably will continue to be some advantage in moving the traffic by way of an existing eastern outlet, or by one of the lines under construction (as the Hudson Bay route), except in the case of a limited traffic for Pacific destinations.

Southern British Columbia is more rugged than the central and northern parts of that province, hence the section closest to Vancouver contains less land well suited to agricultural and pastoral pursuits than the middle and up-

per Fraser basin, about equidistant from the two ports. Agricultural and pastoral possibilities, however, are not likely to operate in a large way in the development of these areas during the next few years, mainly because the difficulties confronting agriculture in the Cordilleran region are serious enough to give the prairie lands all the advantage in attracting agricultural colonists and labor. Two facts alone are adequate to support this conclusion. (1) Most of the cultivable lands of the Cordilleran region are forested, and impose on the prospective farmer an expenditure of time, labor, and capital so great that the whole cost of preparing the land for plowing may be greater than would be justified by the expectable returns from its cultivation. (2) A good many tracts, properly classified as arable lands, are for climatic reasons suitable only for hardy cereals (oats, barley, rye), vegetables, and some small fruits; but for such crops there is little demand in that region or any other within reach.

The forest resources are far more significant to the development of the region, for much of the southern half of British Columbia consists of ultimate forest land. The best and heaviest stands are toward the south, in the section tributary to Vancouver. In the central part of the province, especially along the Nechako-Skeena route to Prince Rupert, large tracts of forest now have little or no commercial value (Fig. 8). Some large areas have been injured or destroyed by fires, mainly during the last quarter of a century. Other large areas are covered with a growth of small-sized and inferior spruce, hemlock, and poplar. These forests might be exploited profitably to produce pulp wood, posts, fence rails, railroad ties, and the like, were there a large accessible market for them. Very few tracts of good saw-log timber are found as far north as the 54th parallel, or the approximate vicinity of the Skeena route. The line tributary to Prince Rupert, therefore, lies near the northern limit of cultivable crops and of valuable commercial forests in British Columbia and cannot derive much advantage from these two resources.

In the matter of mineral resources few deposits comparable to those in the Selkirk and Gold Ranges and other parts of southern British Columbia have yet been found in the more northerly localities, though exploration is likely to reveal new riches; but no great commercial port ever has been developed by traffic resulting from the production of ores alone. The northern section seems quite deficient in supplies of fuels of good grade, as a result of which a serious handicap may be imposed on its mining development as compared with the southern section, where an abundance of high-quality coal is available, such, for example, as the coal from Vancouver Island and the Kootenay region. All the important coal fields now known in British Columbia and nearly all the great coal supplies of Alberta lie within a 500-mile radius of Vancouver, with the greater part of these fields tapped by lines of transportation which naturally are tributary to that Pacific port. On the other hand, only a small part of the coal fields of

FIG. 6—The coast of British Columbia near the mouth of the Skeena River.

British Columbia (such as the Telkwa field in the upper Skeena basin) and the northern (poorer) end of the Alberta field lie within a similar radius of Prince Rupert, while from many of these coal areas there are no natural lines of movement tributary to that port. The natural resources in the Cordilleran section, therefore, give an overwhelming advantage to the Vancouver region.

Turn now to a comparison of the prairie regions tributary to the rival ports. The distance from Vancouver is materially shorter than the distance from Prince Rupert to the prairie area which is now developed, or is likely to have any large development in the near future (Fig. 5). Thus Edmonton, typical of the northern part of the prairie area, is but 755 miles (Canadian Northern Railway) from Port Mann and is 955 miles (Grand Trunk Pacific Railway) from Prince Rupert. This means, of course, that through all of the strip of prairie country from the international boundary northward beyond the Athabaska valley, the distance traveled to Vancouver need not be so great as that to Prince Rupert, unless a direct line of railroad is built through Peace River Pass, via the Oslinka to the Skeena. Such a line has not yet been projected.

The southwestern part of the Canadian prairie country, especially that part west of the 105th meridian and south of the Saskatchewan River, is agriculturally less valuable than sections farther to the east and to the north, on account of the scanty rainfall. The development of irrigation projects in the region south and east of Calgary has produced some conspicuous results, as at Lethbridge; but this basis of progress is not at all comparable to the prospects for agricultural development in the more northerly sections without irrigation. Evidently, then, the better parts of the western prairies lie farthest from Vancouver and closest to the passes over the Rockies (Yellowhead and Peace River) by which the Skeena route may be reached. Will this suffice to give Prince Rupert a commercial development greater than that which Vancouver can attain?

The southern prairie section will seek its western outlet mainly via Calgary and the Kicking Horse Pass (Canadian Pacific Railway) through the South Thompson-Fraser route to Vancouver. In spite of heavier grades along that line (Fig. 5), any other western Canadian outlet would involve distances so much greater that it could not possibly compete successfully. For the northern section there are two low passes now occupied or in the future presumably to be occupied by railroads to the Pacific. The Yellowhead Pass west of Edmonton is crossed by the Grand Trunk Pacific to reach the Nechako-Skeena route to Prince Rupert, and by the Canadian Northern to reach the North Thompson-Fraser route to Port Mann. The Yellowhead Pass offers the natural western exit from much of the good prairie section north of the Red Deer River and from all the section about Edmonton and north through the Athabaska country. The Peace River Pass, about 250 miles to the north, presumably will be crossed by a railroad

which will serve as the logical western exit from that most northerly agricultural region, via the Parsnip either to the main Fraser or to the Nechako-Skeena route or via the Oslinka to the northern Skeena (Fig. 1).

From these two passes, Yellowhead and Peace River, as is not the case with Kicking Horse, routes lead both to Vancouver and to Prince Rupert. The Yellowhead Pass is nearer (200 miles) to Vancouver than to Prince Rupert (Fig. 1), while Peace River Pass is nearer to Prince Rupert than to Vancouver. From the Yellowhead, via the North Thompson-Fraser route to Vancouver, grades are lower (Fig. 5) than via the Nechako-Skeena route to Prince Rupert. Thus, all prairie traffic seeking an exit by the Yellowhead would find shorter distance and more favorable grades to the coast if routed to Vancouver instead of Prince Rupert.

From the Peace River exit, for the future agricultural development in the north, the best railroad route to the coast lies along the Parsnip, into the upper waters of the Fraser (North Fork) above the junction of the Nechako, for which route a railroad (extension of the Pacific Great Eastern) already has been projected. Thus the traffic from the Peace River region, following that route, would find somewhere near Fort George on the Fraser a point from which there are two ways of reaching the coast: westward to Prince Rupert (Grand Trunk Pacific Railway) through the Nechako-Skeena route, and southward to Vancouver (Pacific Great Eastern Railway) through the main Fraser route.[2]

With approximate equality of distance, the southern route has a distinct advantage in handling traffic from the dividing point at Fort George.

It is necessary, now, to take into account the destinations of western Canadian products, for the coastwise distance between Vancouver and Prince Rupert might offset the advantage of taking goods to the port nearer foreign destinations. It already has been noted that Prince Rupert is nearer to Alaskan and northern Oriental markets, while Vancouver has the advantage in the case of southern Pacific and Atlantic markets. The comparative importance of these respective areas as destinations for Canadian staple exports is so well known that it needs little discussion. Agricultural products, lumber, and minerals from western Canada, all find their best markets in Atlantic and southern Pacific localities. For a long time to come, if not permanently, this condition will exist. There is, then, a strong likelihood that the bulk of the traffic, even from the more northerly part of the prairies, will be drawn toward Vancouver, because of favorable distances for the land haul, easy railroad grades, and location of the port with respect to principal foreign destinations. Even for traffic moving to Oriental markets it is not impossible that the saving of more than 200 miles in land haul would more than offset the shorter ocean carriage from Prince Rupert, 480 miles nearer Yokohama than is Vancouver.

[2] The Pacific Great Eastern leaves the main Fraser route at Lillooet, above the junction of the Thompson, and crosses two low divides to reach the Cheakampus River and Montagu Channel (Howe Sound), which are followed to North Vancouver. This saves some mileage but, more important, avoids the narrow lower Fraser valley, already followed by two railroads, with little room for another.

FIG. 7.

FIG. 8.

FIG. 7—One of the typical new towns springing up on the prairies of Saskatchewan.

FIG. 8—The "town" of Pacific, B. C., on the narrow flat of the Skeena River, 120 miles east of Prince Rupert. Note the steep slope in the background.

There is left to consider only the effects of incoming traffic on the development of these two commercial centers. It has been claimed repeatedly as one of the assets of Prince Rupert that its trans-continental railroad connections offer the shortest possible line of communication between the Far East and eastern Canada or western Europe and that this possibility of expeditious transportation ought to make the place an important center for handling Oriental wares for Canada, the United States, and western Europe. The savings of distance and time, however, compared with other routes from the Far East, are not great enough to weigh very heavily in the movement of anything except mails, perhaps passengers, and possibly the highest class of package freight. The area which can be served most easily by Prince Rupert, as an import center, now has and for a long time presumably will have only a rural population with but little demand for Oriental wares. There is small chance, therefore, for the immediate development of an import trade of any large proportions through Prince Rupert from China and Japan. The best prospect for the development of import trade at Prince Rupert is to be found probably in the fresh-fish traffic from northern British Columbia and Alaskan waters to markets in Canada and the United States. In that respect, Prince Rupert has a distinct advantage over any other Pacific port, because of the saving of time in transit for a perishable commodity; but, judging from other fishing centers, that activity is not likely to contribute greatly to the commercial development of Prince Rupert.

Vancouver, on the other hand, is close to more important centers of population both in Canada and in the United States with increasing demands for Oriental wares, the handling of which will, as heretofore, contribute materially to the commercial progress of that center. Of late years one of the large items in the traffic at Vancouver has been raw silk from China and Japan destined largely for factories in the United States. This traffic, for example, probably could not be diverted to Prince Rupert, because of the much longer land haul from the port to the ultimate destination. Thus Winnipeg, the common point on the eastbound journey for all western Canadian lines, is 1,748 miles from Prince Rupert and 1,484 miles from Vancouver. Similarly, other Oriental wares logically would enter in greater amounts through Vancouver, because of established lines of shipping, solidly intrenched commercial relations, and the number and distribution of people composing the market.

Putting together all these considerations of location, distances, character of tributary areas, routes of transportation, and distribution of population, the sum-total of geographic factors affecting the Vancouver center seems to insure it a continuance of prosperous development. On the other hand, the combination of factors affecting the Prince Rupert center is so unfavorable that only very slow and unimportant development seems to be in store for it for years to come.

CULTURAL FEATURES AND THE PHYSIOGRAPHIC CYCLE

By JOHN L. RICH
University of Illinois

Does geographical environment control human distributions, industries, habits, customs, and other activities and qualities? How far does this control extend and through what agencies does it operate? These are some of the fundamental problems of geography. In an attempt to put the investigation of at least one aspect of the broader problem on a detailed quantitative basis, the writer has set the following query: To what extent are the location and distribution of cultural features, such as towns and clearings in the forests, controlled by topography; and how closely may the facts of location and distribution be correlated with recognized stages in the normal physiographic cycle? No attempt is here made to determine the effects of complications in the cycle.

Stages in the Physiographic Cycle

In order that there may be no confusion of meaning in the use of the terms that designate the various stages of the physiographic cycle, the essential topographic characteristics of each stage are stated briefly:

Youth: The greater part of the original upland surface still intact; valleys narrow, steep-sided, and without prominent flood-plains.

Late youth: Valleys wider and considerable parts of the original upland still undissected.

Early maturity: Fragments of the original upland still remaining, but occupying less than one-fourth of the area; valleys narrow and steep-sided, with minor bottom lands here and there along the larger streams.

Maturity: Original upland completely dissected; V-shaped valleys and ridgelike divides; slopes steep; flood-plains narrow and mainly along larger streams; valley-side profiles nearly straight lines, or convex upward.

Late maturity: Valleys wider at the bottom than in maturity; lower slopes gentle; upper slopes steep; divides narrow and relatively sharp; flood-plains conspicuous along streams; valley-side profiles concave upward.

Old age: Lower slopes gentle and valley bottoms wide; divide ridges narrow and becoming lower as the age increases; flood-plains broad.

Extreme old age: All slopes gentle; divides low and narrow; flood-plains broad.

Cultural Features

For the sake of definiteness and simplicity, only four types of cultural features have been considered. These are: clearings in the forests (on maps

on which forests are shown), roads, houses, and towns. All of these are represented on the accompanying maps (forests being indicated by a darker tint on Figs. 4 and 5). Each of them is vitally related to the life and occupations of the people. From their location and distribution much can be determined concerning the life and work of the people, the nature of their farms, and the physical and social difficulties against which they must contend.

Method of Work

In order that the investigation might be put upon a quantitative basis and freed from personal errors the following procedure was adopted:

1. From the latest topographic maps, all on the same scale, a number of examples of topography in various stages of the physiographic cycle were chosen.

2. For study, a definite and uniform area, namely a five-minute rectangle on each map, was selected, care being taken to choose an area having a uniform type of topography throughout.

3. A graph was prepared, and the stages in the cycle were plotted along the horizontal axis, and percentages along the vertical axis. The stages represented were youth, late youth, early maturity, maturity, late maturity, old age, and extreme old age. The cycle was thus rather minutely subdivided in order to facilitate the placing of regions whose stages are intermediate between youth, maturity, old age, and the final stage of extreme old age.

4. Each area chosen for study was next classified under its appropriate heading and its proper position on the graph was plotted.

5. All roads on each rectangle were then measured and classified, as to location, in the following groups:

(a) Bottoms. Roads along valley bottoms close to streams or on the stream flood-plains.

(b) Interfluves or uplands. Roads on the upland ridges and divides.

(c) Slopes. Roads distinctly on valley slopes, extending either along or up and down the slopes, unless distinctly pass roads.

(d) Passes. Roads across valleys from upland to upland, or across divides from valley to valley.

The mileage under each classification was determined and its percentage of the total was calculated and plotted on the graph for roads, Figure 1. The same procedure was followed and the same classification was made for houses and towns, except that on some sheets displaying uniform topography the towns of the entire quadrangle, or of considerable parts of it, were counted. Any group of ten or more houses was classed as a town.

The percentages for houses and towns on interfluves, bottoms, and slopes were then plotted on their respective graphs, Figures 2 and 3. Smooth curves were drawn as nearly as possible through the points thus located.

The construction of the graph for towns differs from that of the others in that the percentages for all the maps of each stage were averaged and this average was plotted at the center of the space for that stage, because the number of towns on most of the quadrangles was too small to give reliable results if plotted separately.

The areas measured and plotted on the graphs represent considerable variety both in locality and in relief for each of the stages. It is note-

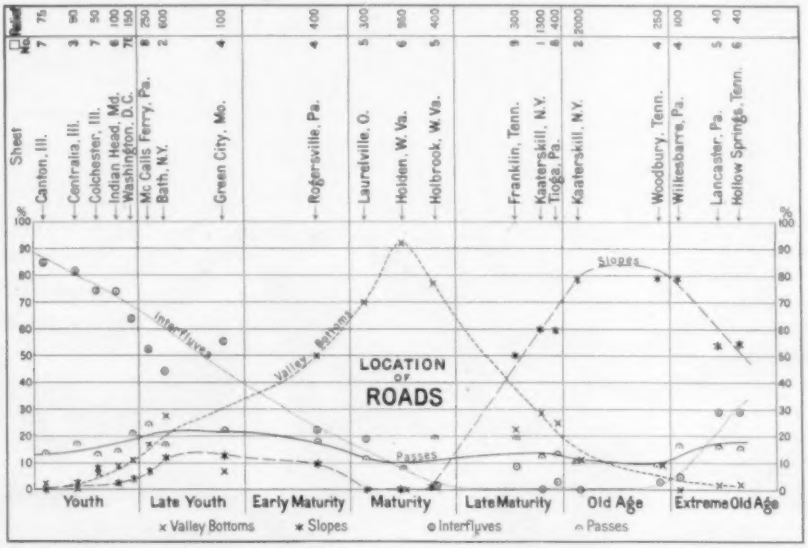


FIG. 1—Diagram illustrating the relation between the location of roads and the physiographic stage of the topography.

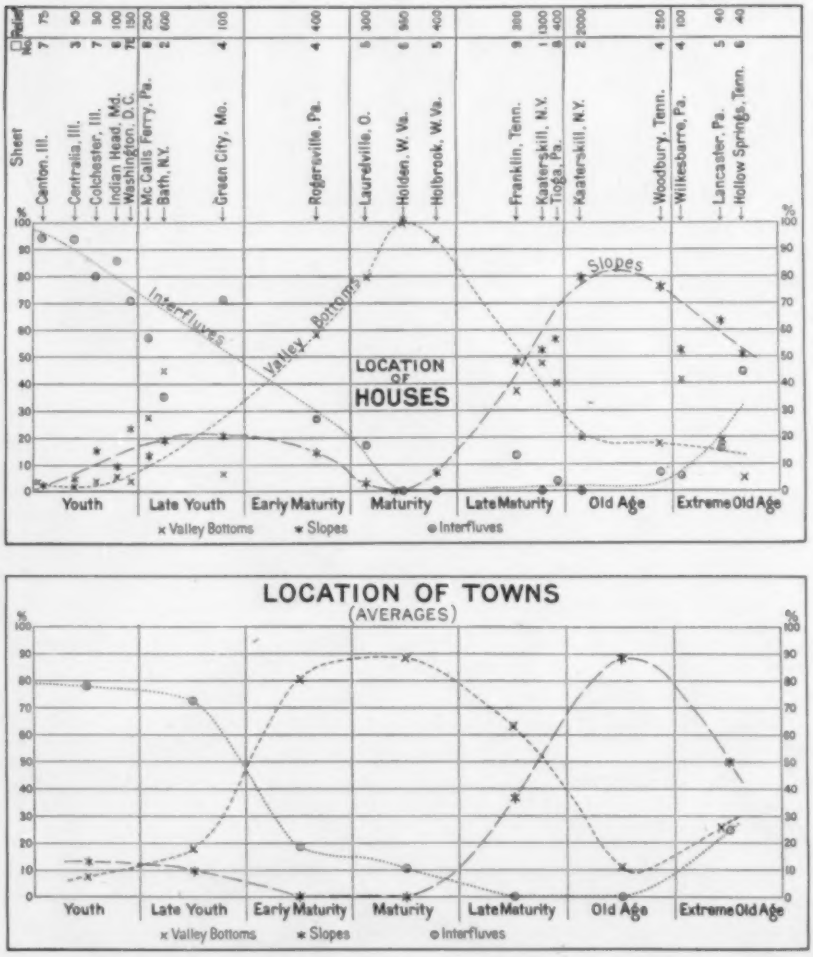
The stages of the physiographic cycle are plotted along the horizontal axis and the percentages of occurrence of roads on topography of a given stage along the vertical axis. Four types of roads are differentiated by symbol. The areas chosen for study, five-minute rectangles on the topographic sheets of the U. S. Geological Survey, are indicated in the upper part of the diagram, the position of each rectangle within its sheet being indicated by the numbers under the heading "□ No." (the nine rectangles, arranged in three rows of three, are numbered consecutively from left to right, beginning with the top and ending with the bottom row). The figures at the top of the diagram, headed "Relief," give the mean elevation in feet of each five-minute rectangle.

worthy that the correlation holds in its essentials for regions of considerable differences in relief, though it is plain that high relief tends to make the topographic control more nearly dominant.

ANALYSIS OF THE CURVES

Houses. In youth a large percentage—80 to 95—of the houses are on the uplands and only a few in the valley bottoms, Figure 2. On several of the maps a considerable number are located on the premature old-age topography at the heads of the larger valleys and are classified as on slopes. With advance toward maturity the percentage of houses on the

uplands decreases to zero, whereas for those on the valley bottoms it increases to 100. In late maturity and old age the percentage of houses on slopes increases to 60 or 75, while that for valley bottoms drops to less than 50. In extreme old age, locations on slopes and interfluves dominate (the



FIGS. 2 and 3—Diagrams illustrating the relation between the location of houses and towns and the physiographic stage of the topography. For explanation of symbolism, see Fig. 1.

abrupt falling off of the curve for valley bottoms is due to slight rejuvenation in all the areas measured).

Roads and Towns. The graph for roads, Figure 1, repeats the essential features of that for houses, as would of course be expected. The only

noteworthy difference is the addition of the curve for "passes" which lies very uniformly between 10 and 25 per cent. The rise to 25 per cent in late youth is due to the increased width of the valleys while culture is still mainly on the uplands. The sharp rise of the road curve for "interfluves" and the fall for "bottoms" is similar to that for houses and is due to the same cause. The graph for towns, Figure 3, repeats all the essential features of the other two.

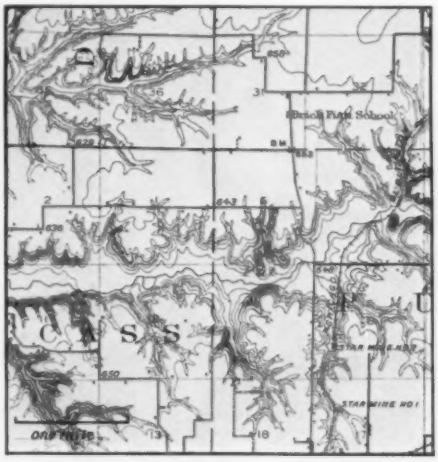


FIG. 4—Youthful topography on the plains of Illinois. Part of Canton, Ill., quadrangle, five-minute rectangle No. 7 (see explanation under Fig. 1). Note that culture is almost exclusively on the uplands. The eighth, quarter, and half-mile jogs of the roads by which the section-line system is made to conform to the topography is well illustrated in the southwest corner of the map.

The graphs show clearly that there is a close correlation between the enumerated cultural features and the specified stages in the physiographic cycle. In nearly all instances the percentages for the different regions fall surprisingly close to the general curve. The similarity in the form of the curves for each of the three cultural features shows that the location of all is controlled in essentially the same way by the topography and that all are capable of the same topographic correlation. The location of cleared land, though not measured quantitatively, may readily be seen to accord with that of the other features. For the purposes of the following summary statement of the correlation it is, therefore, possible to group houses, towns, roads, and clearings together under the general head of "cultural features."

SUMMARY STATEMENT OF THE RELATION OF CULTURAL FEATURES TO STAGES IN THE PHYSIOGRAPHIC CYCLE

The correlations implied in the graphs may be verbally expressed as follows:

In youth what may be called *upland culture* prevails to the extent of 60 to 90 per cent of the total. Houses, farms, roads, and towns are on the uplands. Valleys are avoided and as a rule are left forested. The valleys are crossed only in passing from one upland to another (see Fig. 4).

As the stage of the topography approaches maturity and the flat upland areas decrease in relative proportions and the flats along the streams increase, there is every gradation to the second principal stage, maturity.

The distribution of culture follows very closely that of the flatter land both in location and in percentage.

In maturity, with steep slopes and narrow ridge divides, *valley-bottom culture* prevails almost to the exclusion of all other types. All cultural features are closely confined to the valleys, and the uplands and slopes are, in general, avoided (Fig. 5).

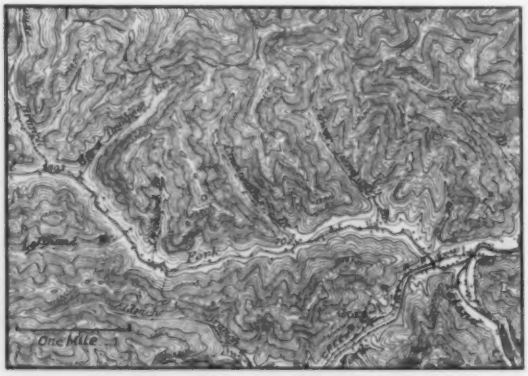


FIG. 5—Typical mature topography in a region of considerable relief. Holden, W. Va., quadrangle, rectangle No. 6. Note the exclusive development of "valley bottom culture."

In late maturity and old age, when the valleys are wide and their lower slopes are gentle, *slope culture* predominates. All cultural features are prevailingly located on the slopes part way up from the streams. In valleys of considerable relief the roads with accompanying houses are most commonly built along the valleys part way up the slopes (see Figs. 6 and 7). The reasons for this location seem to be that thus the stream flood-plains and cut-bluffs are avoided, the ground is drier, and the houses are located nearer the centers of farms which extend from valley bottom to divide.

The correlation with the extreme old age stage cannot be satisfactorily made from the data on the graphs because of the slight rejuvenation which all the regions seem to have suffered. There is nevertheless a distinct tendency toward the development of the *unguided* culture, which would be expected as the plains condition is approached, and which is the characteristic type on plains.

Basis of the Topographic Control of the Location of Cultural Features

Topography, in its relation to human activities, may be analyzed into three components—relief, including elevation; slope, or inclination of the surface; and exposure.

Relief exerts its most direct and powerful influence through the work which must be done against gravity in ascending from one level to another. To escape the necessity of performing this work man avoids hill ascents whenever and wherever possible, consequently all cultural features tend to be so located with respect to the outside world and to one another that the least possible amount of climbing is necessary. In consequence, if the farms

of a region are on the uplands, there is a tendency for all the other cultural features to be located there also. Certain features, such as railroads, are more sensitive to gravity effects than others and are, therefore, more strictly limited in their location. They may, for instance, be confined to the valley bottoms in regions where all the other cultural features are on the slopes or the uplands. A good example of this is found on the Fayetteville, West Virginia, quadrangle, where the through-line railroads are confined to the valley of New River, though all other cultural features of the region, except certain coal mines and railroad towns, are on the uplands. Where the relief is great, the effect of altitude on temperature may be great enough to assume prime importance.

FIG. 6—A specimen of late-mature or early-old-age topography on which slope culture is well developed. Kaaterskill, N. Y., quadrangle, rectangle No. 2. Onteora Park, a summer resort, probably owes its location abnormally high on the slope to a combination of the factors of elevation and the excellent view which the location commands.

In its influence on human activities, particularly where agriculture is the prevailing industry, doubtless slope declivity is the most important single element of the topography. On slope depends the rate of run-off of the rainfall, and, to a large degree, the character of the soils, since the finer materials tend to be washed off the steeper slopes and the coarser, stony materials to be concentrated and left behind. Ease of cultivation is similarly conditioned by slope gradients. In all these respects the gentler slopes are most favorable, though there are exceptions due to specialized industries like the grape-growing of the Rhine valley, where exposure exerts the dominating control. The influence of exposure to sun and wind varies greatly under different conditions of climate. It is exerted directly, as well as indirectly through agriculture.

Of the three components of topography, slope seems to be the one which exerts the strongest influence over the location of cultural features in the regions included in this study. The graphs drawn to show the location of these features in relation to topography and stage in the cycle might almost as well be used to express the location of the flat or more gently sloping land, so closely do the two correspond. To express the idea briefly: *The*

FIG. 7—Slope culture in a late-mature valley in the Catskills (valley of Town Brook, Hobart, N. Y., quadrangle). Houses, roads, and the most important parts of the farms are on the slopes well above the valley bottoms.

topographic control over the location of cultural features is exerted mainly through the agency of slope supplemented by relief and, to a less degree, by exposure.

Such a close relation between slope and the distribution of cultural features is to be expected, particularly in a region like the United States, where agriculture on an extensive rather than an intensive scale is the prevailing industry. The farms are located on the more level land where the soil is best and cultivation is easiest. The houses and towns are located where the least amount of hill climbing is necessary in traveling from house to farm or from farm to town. The roads—the connecting links between these features—accord with them in location.

The Dominance of Topographic Factors in Controlling the Location of Cultural Features

To what degree topography dominates competing human factors in controlling the location of cultural features is a broad problem which has been touched upon only incidentally in connection with the present study. Two of the cultural features, namely towns and roads, supply data on the subject.

Towns. Towns of two types, rural or agricultural, and mining towns, are represented on the maps studied. The former predominate; and their locations are obviously controlled principally by those factors which control the locations of farms, houses, and roads.

Unless topographic factors are strong enough to exert a dominating influence, it would be expected that the location of mining towns would be controlled by the sites of the mines. In order to test this theory, the distinctively mining towns on the quadrangles from which type areas were studied have been listed and the data on the topography and on the locations of the mines and of the towns have been assembled in the following table:

Table Showing Relative Topography of Mines and Mining Towns

Quadrangle	Name of Mining Town	Topography of Neighborhood of Mine	Location of Mine	Location of Town
Holden, W. Va.	Holden	Mature	Near bottom	Bottom
	Cora	Mature	About 100 ft. up slope	Bottom
	Stone Branch	Mature	150 ft. above main stream in gulley	Bottom
	Kitchen	Mature	150 ft. up slope	Bottom and on lower 50 ft. of slope
Eccles, W. Va.	Wevaco	Mature	800 ft. up slope	Bottom
	Dorthy	Mature	About 1,000 ft. up slope	Bottom
	Keeferton	Mature	800 ft. up slope	Bottom
	Kingston	Mature	500 ft. up slope and in valley heads	Bottom
	Herbertson	Late mature	1,200 ft. up slope near top	On slope 100-150 ft. above stream
Canton, Ill.	Alden Mine No. 6	Youthful	Upland	Upland
	Alden Mine No. 5	Youthful	Upland	Upland
	Several smaller communities: mines and communities both on uplands.			

The table shows that the mining towns are located in strict accord with the topography. On mature topography they are in the valley bottoms,

irrespective of the location of the mines; on the one example of late-mature topography the town is on the slope; and on the youthful topography all cultural features, including both mines and towns, are on the flat uplands.

The number of observations tabulated is, of course, too small for generalizations, but the table furnishes interesting confirmation of the results of the graphs and serves to indicate that topography is the controlling factor in the location of these mining towns as well as of the strictly rural communities.

Roads. With respect to the roads, the maps studied cover regions in which the road pattern is irregular and those in which the rectangular section-line system prevails. The latter system, if consistently carried out, must inevitably conflict seriously with the topography in any but plains regions, in which case either the section-line system must be modified or it must be followed in direct defiance of topography. By reference to the graph, Figure 1, it may be seen that for topography in the youthful stage the percentage of roads on uplands, bottoms, and slopes is about the same for the quadrangles, e. g., Canton, Centralia, and Colchester, in which the section-line plan has been followed, as for the quadrangles, e. g., Indian Head and Washington, in which the roads are not laid out with reference to any definite system. An inspection of the Canton map, Figure 4, shows that the section-line plan has been modified by means of jogs on one-half or one-fourth mile lines in such a way that the general plan is retained but the roads are located in reasonable conformation with the topography.

Application of Results

This paper represents only the beginning of the quantitative study of the distribution of population by a new method, and its conclusions, which are based upon limited data and are primarily applicable to those regions in which agriculture is the principal industry, should not be made the basis of unqualified generalizations. Especial importance is attached to the method and to the graphic representation of the results. The study was purposely confined to regions whose topography represents, as nearly as could be found, various stages in the ideal physiographic cycle as developed on dissected plains or plateaus. Obviously the results cannot be applied without modification to regions whose topography is complicated by remnants of surfaces belonging to two or more cycles or to those whose climatic and cultural conditions are notably different, and it is doubtful if it can be applied at all to regions—basin regions for example—whose topography is not definitely a product of the normal cycle of stream erosion, and such regions make up a very considerable portion of the earth's surface.

The location of cultural features and the distribution of population are controlled by a number of factors, among which topography, climate, the occupations of the people, and their grade of civilization are perhaps most important. The influence of topography on locations is conditioned to a greater or less degree by the other factors. In attempting to work out, on

a broad basis, the correlation between topography and the location of cultural features by the method outlined above, either of two plans may be adopted: (1) the correlation may be worked out separately for each principal type of climate and for each of the leading industries, or (2) certain conditions, e. g., humid climate and modern agriculture, may be taken as the *normal*, or perhaps better, the *standard* conditions, giving rise to the *normal* locations and distribution with respect to topography in the various stages of the ideal cycle; while variations from the normal brought about by complications of the cycle, different climatic conditions, different grade of civilization, or specialized industries may be considered as modifications due to particular causes. To illustrate: The accompanying graphs represent the correlation for a region of humid temperate climate where extensive modern agriculture is the dominant occupation of the people. Adopting the first plan, similar graphs might be prepared for regions where tree culture or grazing prevails or for those where intensive hoe cultivation is practiced. They might also be prepared for regions of arid, tropical, or cold climates. Following the second plan, which on the whole seems to be preferable, and accepting humid climate and modern agriculture as standard conditions, modifications of the normal locations and distribution would be recognized as such and related to their causes. For example, on youthful topography the normal is "upland culture," on late mature and old age topography it is "slope culture." In high altitudes, the climatic influence of elevation may make the uplands too cold and wet for habitation and compel settlement of the topographically unfavorable valley bottoms. Similarly, in an arid climate the necessity for irrigation may limit the culture of a young region to the valley bottoms. In the tropics, on the other hand, the cooler climate of the higher altitudes puts so high a premium upon altitude that not only may the flat uplands of youth be occupied to the fullest extent, but even the less favorable, narrow uplands of maturity may be utilized. Still greater altitude in the tropics, as in the Andes, may render the uplands fit only for the nomadic herdsman while the steeply sloping valley sides, on account of their more favorable climate, are laboriously cultivated. Each of these conditions brings about a modification of the normal distribution of cultural features which is easily traced to its cause.

Modifications of the normal locations due to complications of the cycle fit readily into the scheme. For instance in many parts of the Appalachian Plateau (see Big Bend quadrangle, W. Va.) late-mature topography has been rejuvenated and the bottoms of the broad valleys of the earlier cycle have been sharply trenched by the precipitous valleys of the new. With respect to the new cycle "upland culture" would be normal; with respect to the old cycle "slope culture" would be expected. As a matter of fact both expectations are fulfilled by the location of practically all cultural features on the gently sloping benches above the youthful valley sides.

The factors which constitute the basis of control exerted by topography—

namely relief, slope, and exposure—are so fundamental that it would seem that they must have weight whatever the industry or the stage in civilization may be, though either of the latter must modify the result. If modern agriculture, with machine cultivation and transportation by wheeled vehicles, be taken as the standard in determining the normal location of cultural features, then it would be expected that industries such as grazing or tree culture would introduce modifications in the direction of less absolute topographic control. So, also, would a stage in civilization in which transportation is primitive and cultivation is done by hand. An entirely non-agricultural and mobile industry like trapping would probably be so little controlled by topography that its correlation with stages of the cycle would be impracticable. Pressure of population or specialized industries resulting in terrace agriculture bring about modifications in the location of cultural features whose significance is the more marked when they are recognized as abnormalities due to specific causes. The location of cities and villages on crags and hilltops for defensive purposes offers another illustration of a modification of the normal readily recognized and easily traced to its cause.

Which of the plans mentioned above would yield the best results is open to discussion, but under either plan the application of the method to various parts of the world where climatic and cultural conditions are notably different is highly desirable.

Bearing of Location of Cultural Features on the Broader Problem of the Influence of Geographical Environment

If, in a given region, the location of houses, towns, and roads may be definitely correlated with the stage in the physiographic cycle, does it follow that the location of these features influences the life and character of its people? This is the ultimate problem to the solution of which this correlation is only the first step.

That the character of the topography exerts a very positive influence over the economic phases of life, and, through these, over the more subtle human qualities, will probably be conceded by all; but does the mere location exert a similar influence? To answer this question on a definite scientific basis will require long investigation, some of it distinctly in the realm of psychology, and will be the work of many years. A possible guiding principle may, however, be suggested. *The location of the farms, houses, and towns of a region determines the topographic environment and scenic outlook of the inhabitants.* Contrast, for example, the environment determined by youthful and by mature topography. In the one the people live on the uplands where they command the full sweep of land and sky. Their view is broad and open. In the other they live along the bottoms of the narrow, steep-sided valleys, hemmed in by hills. Their outlook is limited to their immediate surroundings; there are no broad commanding vistas.

The geographer can define the environment and classify and explain its elements: can the psychologist determine its effect in moulding character?

MARKLAND, OTHERWISE NEWFOUNDLAND

By W. H. BABCOCK

The name Markland, meaning Forest Land, must be, in one language or another, among the oldest geographical designations known among men. Nothing could be more natural to even the most primitive people than to distinguish in this way any heavily overgrown region which especially challenged attention, perhaps as a refuge or as a barrier. Its appearance in any form of record was, of course, very much later. As to Atlantic regions, the earliest instance other than Norse may be the "Insula de Legname" of certain fourteenth- and fifteenth-century portolan charts,[1] evidently given by some Genoese or other Italian navigator to Madeira, the latter name being a translation of the former, substituted by the Portuguese[2] after their rediscovery. Thus we might say that this island was the original western Markland, but for the fact that certain Greenland Norsemen had affixed the name long before to a region much farther west.

The earliest manuscript of the first distinct account of the Norse Markland is included in the compilation known as Hauk's Book,[3] from Hauk Erlendsson, for whom and partly by whom it was prepared, necessarily before his death in 1334, but probably after he was given a certain title in 1305. Perhaps 1330 may mark the time of its completion. Along with divers other documents, it copies from some unknown original the saga of Eric the Red, sometimes called the saga of Thorfinn Karlsefni, an ancestor of the compiler, whose adventures as an early explorer of northeastern North America constitute a conspicuous feature of the narrative. Some parts of the saga of Eric the Red as thus transcribed, especially toward its ending, cannot be much older than the time of transcription, but verses embedded in other parts have been identified as necessarily of the eleventh century; and the body of the tale is, for the greater part, manifestly archaic.

Beside Hauk's Book, there is a corroborative, independent, but almost identical manuscript copy of the saga—No. 557 of the Arna-Magnæan collection at Copenhagen.

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[1] Portolano Laurenziano-Gaddiano, 1351; see Pl. 5 of facsimile in Portfolio V of Theobald Fischer: Sammlung mittelalterlicher Welt- und Seekarten italienischen Ursprungs, 1 vol. of text and 17 portfolios containing photographs of maps, Venice, 1877-1886.

Catalan atlas, 1375, Pls. 11-14 in A. E. Nordenskiöld: Periplus: An Essay on the Early History of Charts and Sailing Directions, Stockholm, 1897.

Pareto map, 1455, Pl. 5 in atlas accompanying K. Kretschmer: Die Entdeckung Amerikas in ihrer Bedeutung für die Geschichte des Weltbildes, 2 vols. (text and atlas).

[2] M. d'Avezac: Notice des découvertes faites au Moyen-Age dans l'Océan Atlantique antérieurement aux grandes explorations Portugaises du quinzième siècle, Paris, 1845, pp. 8-9. See "I de Madera" on Benincasa map, 1482, K. Kretschmer, *op. cit.*, atlas, Pl. 4.

[3] Fully set forth in A. M. Reeves: The Finding of Wineland the Good, London, 1890; summarized in W. H. Babcock: Early Norse Visits to North America, *Smithsonian Misc. Colls.*, Vol. 59, No. 19, pp. 64 *et seq.*, Washington, D. C., 1913.

This saga[4] tells us:

"Thence they sailed away beyond the Bear Islands with northerly winds. They were out two *daegr* (days); then they discovered land and rowed thither in boats and explored the country and found there many flat stones (*hellur*) so large that two men could well spurn soles upon them [lie at full length upon them, sole to sole]. There were many Arctic foxes there. They gave a name to the land and called it Helluland.

"Thence they sailed two *daegr* and bore away from the south toward the southeast and they found a wooded country and on it many animals; an island lay off the land toward the southeast; they killed a bear on this and called it Þiarney (Bear Island); but the country they called Markland (Forest Land).

"When two *daegr* had elapsed they descried land, and they sailed off this land. There was a cape (*ness*) to which they came. They beat into the wind along this coast, having the land on the starboard (right) side. This was a bleak coast with long and sandy shores. They went ashore in boats and found the keel of a ship, so they called it Keelness (Kjalarness) there; they likewise gave a name to the strands and called them Furdustrandir (Wonder Strands) because they were so long to sail by. Then the country became indented with bays [or "fiord-cut," as Dr. Olson translates] and they steered their ships into a bay. . . . . The country round about was fair to look upon. . . . . There was tall grass there." A very severe winter, however, drove them far southward to a warmer bay, or *hop*, where they dwelt for nearly a year among the characteristic products of Wineland; but at last withdrew after an onslaught of the Indians.

Probably it was from this narrative that Arna-Magnæan Manuscript 194, an ancient geographic miscellany, partly in Icelandic, partly in Latin, derived the following statement, generally ascribed[5] to Abbot Nicholas of Thingeyri who died in 1159.

"Southward from Greenland is Helluland, then comes Markland; thence it is not far to Wineland the Good, which some men believe extends from Africa, and if this be so there is an open sea flowing between Wineland and Markland. It is said that Thorfinn Karlsefni hewed a 'house-neat-timber' and then went to seek Wineland the Good, and came to where they believed this land to be, but they did not succeed in exploring it or in obtaining any of its products."[6]

The above view of the relative positions of these regions along the coast

[4] A. M. Reeves, *op. cit.*, pp. 42 *et seq.* This work gives facsimiles of the pages in Hauk's Book dealing with the saga of Eric the Red, as well as the printed text in Icelandic, also a translation and notes distinguishing slight divergencies of Arna-Magnæan MS. 557. I have followed the latter as slightly preferable and equally authentic and archaic in substance. W. Hovgaard (The Voyages of the Norsemen to America, New York, 1914, p. 108) translates a little differently from Reeves in details but gives much the same purport.

[5] For example by Joseph Fischer: The Discoveries of the Norsemen in America, With Special Relation to Their Early Cartographical Representation (translated by B. H. Soulsby), London, 1903; ref. on pp. 7-8.

[6] Thus quoted in A. M. Reeves, *op. cit.*, p. 15. See also W. Hovgaard, *op. cit.*, p. 79, where the obscure passage in the fourth line above is rendered "Karlsefni cut wood for a house ornament."

is also illustrated in the well-known map[7] of Sigurdr Stefansson (1570, or 1590, according to Storm) which was evidently based on surviving Icelandic traditions.

There is great verisimilitude in the Karlsefni narrative and these later derivative records. Their geography agrees convincingly with the facts of the actual coast line from north to south—namely, first a desolate region, cold, bare, and stony, the appropriate home of Arctic foxes; secondly, a game-haunted and very wild forest land, untempting to settlement, unhopeful for agriculture, but a hunter's paradise; thirdly, the warmer country to the south, well suited to cultivation and even producing spontaneously various kinds of edibles, notably the large fox grapes from which wine might be made. Helluland, the first, remains, as Labrador and perhaps Baffin Land, nearly unchanged excepting some slight uplift of the shore line; Markland has suffered great inroads of the lumberman's axe, but still as Newfoundland contains much heavy timber in its western part; Wineland, the third, has become the chief seat of American civilization east of the Alleghany mountains. But in the time of the Norsemen and long afterward, Newfoundland was a veritable Markland, a land of woods, down to its eastern front.[8] Its rediscoverers and earliest settlers found it so; and the maps of Cantino[9] and Canerio,[10] both attributed to 1502 and certainly not much later, exhibit the great island pictorially, under different names, as a mass of woodland with tall trees standing everywhere, apparently thus commemorating the most distinctive and conspicuous natural feature of the land.

Some have urged that the southern part of Labrador may have been Markland; but its trees of any considerable size are to be found only by following up inlets far into the interior where the Arctic current has less power to chill; there is nothing to indicate that conditions were very different then in this regard; and to judge by the narrative itself we must not conceive of the Norse visitors as pausing to explore deeply without allurement, but rather as hastening down the shore in quest of warmer regions and ampler pasturage for their stock which they carried with them, also of a good warm site for settlement, such as Leif had already reported. They were primarily colonists, not explorers of the disinterested or glory-seeking type. It was most natural to sail on; noting only what they could discern from the sea, or by a brief boat-landing. This would hardly give them the idea of a forest land in any part of hard-featured, ice-battered Labrador.

It is probable that, like some later navigators, they would not think of

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[7] First reproduced by T. Torfaeus: Historia Vinlandiae Antiquae, Copenhagen, 1705 (translated by J. G. Shea in *Catholic Historical Magazine*, 1888). Reproduced later by various authors, notably G. Storm: Studies on the Vineland Voyages, *Memoires Soc. Roy. des Antiquaires du Nord* (Copenhagen), N. S., 1888, pp. 307-370.

[8] F. Nansen: In Northern Mists (translated by A. G. Chater), London, 1911, 2 vols.; reference in Vol. 1, p. 323. Cf. R. Whitbourne: A Discourse and Discovery of Newfoundland, London, 1622.

[9] F. Nansen, *op. cit.*, Vol. 2, pp. 350 and 351. E. L. Stevenson: Maps Illustrating Early Discovery and Exploration in America, 1502-1530, New Brunswick, N. J., 1906, Pl. 1.

[10] K. Kretschmer, *op. cit.*, atlas, Pl. 8, map No. 1.

the Straits of Belle Isle as other than a fiord or inlet, after the pattern of the great Hamilton Inlet farther north; and if they guessed Markland to be an island it would be on quite different grounds—chiefly the natural tendency (which persisted until long after their time) to consider every western discovery insular; but they would at least be alive to the distinction between treelessness and an ample forest cover, and we see that in point of fact they did distinguish the regions on just this score.

Certainly this might involve the inclusion of Nova Scotia in the second of the three regions; and there have been many to champion this peninsula as distinctively Markland. But other features of Nova Scotia attracted the attention of Karlsefni's party and gave parts of that land an individuality distinguished from that of the forest country. The great cape Kjalarness, which seems to have been the northern horn of Cape Breton Island, and the exceedingly long strands, which may now be represented in part by the low front of Richmond County, are duly recorded, with no suggestion of their belonging to Markland, the region farther north. Also on the Stefansson map above referred to, the name Promontorium Winlandiae is applied to a long protuberance apparently meant for this part of Cape Breton Island, containing the counties of Victoria and Inverness, and the much earlier statement in Arna-Magnæan Manuscript 194 concerning the sea running in between Markland and Wineland seems to mark all south of Cabot Strait as belonging in some sense to the latter region. No doubt the name Markland may sometimes have been used with vagueness of limitation; but on the whole it seems most likely that Newfoundland was Markland almost exclusively. It seems practically certain, at the least, that the characteristics first noted in Newfoundland supplied the earlier regional name.

In many of the discussions of this exploring saga there has been too great a tendency to localize the territorial names, as though Wineland for example must denote a small area or short stretch of coast. Professor Hovgaard, recently, has even suggested that there may have been two Winelands—Leif's Wineland being much farther south than Karlsefni's, the name in each case standing for some one site or place and the territory immediately about it. This does not accord well with one of the notes on the Stefansson map, which gives Wineland an extension as far as a fiord dividing it from "the America of the Spaniard." That may be read as meaning Chesapeake Bay and must at any rate be taken to suggest great extension for this region, since the Promontorium Winlandiae, as already stated, obviously marks its upper end. Markland need not be conceived as of equal size, for in truth it represents at most only the wild and wooded interval between the hopelessly void and barren north and the great habitable, comfortable, and fruitful region stretching far below; but so much of parallelism holds as will forbid us to anchor the name to any one locality on the Newfoundland shore. Doubtless the long sea front of the great island as a whole is entitled to the name.

No doubt it is surprising, in view of the deep impression which Markland obviously made on the Norsemen from nearby treeless Greenland and Iceland, to find so few subsequent references to the name or indications of a knowledge of the region. There is a well-known and often cited instance recorded in Icelandic annals—in one instance nearly contemporary—of a small Greenland vessel storm-driven to Iceland in 1347, after having visited Markland, the latter name being presented in a matter-of-course way, much as though it were Ireland or the Orkneys. This has sometimes been taken as evidence of a regular timber traffic between Greenland and Markland during the preceding three centuries and more. It shows at least that acquaintance with the more southwestern country had been kept really alive thus long, and that it was not a half-mythical figure on the frontier of knowledge, to be doubtfully sought for, but territory that one might visit without claiming the reward of new and daring exploration or causing any extreme surprise. What Markland had to offer was so decidedly what Greenland needed, and the repetition of Karlsefni's voyage thus far was at all times so feasible, that one must suppose the trips to and fro were not wholly intermitted between 1003 and 1347. Only they have left no clear and unquestionable trace.

Perhaps the nearest approach thereto is a fifteenth-century map[11] preserved in the Ambrosian library in Milan, which presents Greenland (Illa Verde) as a great elongated rectangle of land in northern waters, having a concave southern end. Below this, beyond a narrow interval of water, appears a large round island, the direction certainly calling for Labrador or Newfoundland, probably the latter. The minimizing of the distance between these land masses may indicate some report of the ease with which the crossing was effected. At any rate, unless we are prepared to set aside the testimony of the map altogether as mere fancy work, we must acknowledge that some one had a general impression of land in mass south or southeast of Greenland and reasonably accessible therefrom.

The name Brazil given to this island on the map and its disc-like form link it to the long series of "Brazil islands," approximately in the latitude of Newfoundland, on the medieval maps, beginning with that of Dalorto (1325).[12] Usually, as in this last instance, they have the circular form—sometimes, however, being annular, with an island-studded lake or gulf inside, and sometimes being divided into two parts by a curved channel. Usually, too, the station of this Brazil is pretty near southern Ireland, off the Blasquets, but sometimes it is carried out into mid-Atlantic, and in the

[11] A. E. Nordenskiöld: Bidrag till Nordens äldsta Kartografi, Stockholm, 1892, Pl. 5. Also (reduced) in F. Nansen: In Northern Mists, and in T. J. Westropp: Brazil and Legendary Islands of the North Atlantic, *Proc. Roy. Irish Academy*, Vol. 30, Section C, No. 8, 191[illegible], Pl. 20, opp. p. 260.

[12] A. Magnaghi: Il mappamondo del genovese Angellinus de Dalorto (1325): Contributo alla storia della cartografia medioevale, *Atti del Terzo Congr. Geogr. Italiano, tenuto in Firenze dal 12 al 17 Aprile, 1898*, Florence, 1899, Vol. 2, pp. 506-543.

sixteenth-century maps of Nicolay (1560)[13] and Zaltieri (1566)[14] it is taken clear across to the Banks of Newfoundland or a little nearer inshore. From various mutually corroborative indications, I have been impressed with the belief that it is probably a record of some early crossing of the Atlantic from Ireland; but whatever the explanation, Brazil Island remains one of the most interesting of map phenomena. Its name was somehow passed along to Terceira of the Azores, where there is still a Mount Brazil, and long thereafter to the largest of South American countries.

Its appearance near Greenland and as a substitute for Markland is not easily accounted for. The matter is indeed complicated on this fifteenth-century map by the appearance of a second Brazil (of the channeled type) in the middle of the Atlantic. It may be that the cartographer was familiar with this form and kind of presentation in older maps and did not feel warranted in giving up *that* "Brazil"; but had received convincing information of lands southeast or south of Greenland, with some suggestion of Brazil as a name traditionally associated with such discoveries, and so drew and named it. Undoubtedly the map is the work of a man well acquainted with the first disc form of Brazil and the later channeled or divided form, beside having some knowledge of later discoveries in Greenland and beyond.

There is a parallel to the two Brazils of his map in the two series of Azores on that of Bianco (1448).[15] The latter cartographer retained the original Italian-discovered series, inaccurately aligned north and south, but showed also farther afield the islands of Portuguese rediscovery, properly slanted northwestward, omitting only Flores and Corvo, which the rediscoverers had not yet found or at least had not yet brought to his notice. Another map of about the same period makes the same double showing—certainly a curious compromise between conservatism and progressiveness.

There is perhaps no other news of Markland before it became Newfoundland, unless we may put some glimmer of faith in the much-discussed Zeno[16] narrative, which embodies the tale of an Orkney islander wrecked on the shore of Estotiland (perhaps Escociland—Scotland) a little before the opening of the fifteenth century. He professed to have found there a people having some of the rudiments of civilization and carrying on trade with Greenland, but ignorant of the mariner's compass. The picture given is not incredible and perhaps receives some support from the really extensive works known to have been executed by the Beothuk[17] of Newfoundland

[13] A. E. Nordenskiöld: Periplus, Pl. 27.

[14] K. Kretschmer, *op. cit.*, atlas, Pl. 19, map No. 3.

[15] Theobald Fischer, *op. cit.*, Portfolio XI, Pl. 3.

[16] R. H. Major: The Voyages of the Venetian Brothers Nicolo and Antonio Zeno to the Northern Seas, etc., *Hakluyt Soc. Publs.*, 1st Ser., Vol. 50, London, 1873; and F. W. Lucas: The Annals of the Voyages of the Brothers Nicolo and Antonio Zeno in the North Atlantic, etc., London, 1898—representing opposite sides of the discussion.

[17] George Cartwright: Journal of Transactions and Events during a Residence of Nearly Sixteen Years on the Coast of Labrador, 3 vols., Newark (Engl.), 1792. Republished as "Captain Cartwright and His Labrador Journal," with an introduction by W. F. Grenfell, Boston, 1911; reference on pp. 16-25.

in their later and feebler, though not quite their latest days—such as extensive deer fences, to give their hunters the utmost benefit from the annual migrations. Granted a certain infusion of Norse blood, or even without it, there is perhaps nothing stated of the Escocilanders which may not have been true. As to the name, it is no more strange than Nova Scotia, which still occupies the coast just to the south, and it may have been applied in the same spirit.

Very early in the history of European colonization this Markland—which by its outjutting position was accused of being a New-found-land, again and again with varying designations during the ill-recorded centuries—took under the latter name the position, which it still holds, of the very earliest of the English colonies of the New World.

GEOGRAPHICAL RECORD

AMERICAN GEOGRAPHICAL SOCIETY

Presentation of the David Livingstone Centenary Medal to Señor Ballivián. On July 6, at the American Legation at La Paz, the David Livingstone Centenary Medal of this Society, whose award for the third time since its foundation was announced in the July *Review*, was formally presented by the American Minister, the Hon. John D. O'Rear, to the distinguished Bolivian geographer, Señor Manuel Vicente Ballivián. Invitations were issued jointly in the name of the legation and of the Sociedad Geográfica de La Paz. There were present, in addition to the members of the Geographical Society of La Paz, the Minister for Foreign Affairs, members of the diplomatic corps, and many prominent citizens. In his presentation speech Mr. O'Rear outlined in a graceful and effective manner the long services of Señor Ballivián in promoting geographical research, in encouraging exploration, and in keeping alive the spirit of scientific inquiry both in government publications and in the Bulletin of the Geographical Society of La Paz.

In replying Señor Ballivián said in part:

"The award which you make is all the more precious to me, Mr. Minister, in that this medal not only commemorates the daring explorations of Livingstone among the lakes and about the sources of the Nile in Africa, but also brings to mind the noble efforts made by that distinguished traveler, who, at the same time that he was making geographical discoveries, employed every possible means to put an end to the horrors of human slavery.

"Your country, Mr. Minister, by not allowing the centenary of that intrepid and expert explorer to pass unobserved, has interrupted the sadness we feel as a result of the European War, and has spoken to us, in words of peace and wisdom, of achievements whose importance is world-wide and eternal" (translation by this Society).

NORTH AMERICA

Merchant Adventurers of America. The "merchant adventurer" represents in our minds the spirit of English enterprise in Elizabethan times. The islanders who felt the inspiration of the sea became the creators of empire and of British wealth. Their contribution to geography was by no means slight. How this same sea-spirit was a living force in America about one hundred years ago is described by John Foord in an article entitled "Pioneers in Foreign Trade" in *Asia* for April, 1917. Many of the sailormen hailing from Old Salem and other parts of the Atlantic seaboard were descendants of members of the crews commanded by Drake and Frobisher; and they readily volunteered to man the privateers of the Revolution when a cordon of British cruisers, strung along the coast, was effectively blockading the republic. At first the incentive was prize money. Soon, however, the appeal of commercial ventures, combined with the development of manufacturing, made itself felt.

Great profits were to be made in those days in the trade of the Indies, East or West. Sometimes a vessel would be equipped for one of these two destinations only. More often both would be visited. In time, however, the Far Eastern trade became the most important. Starting with humble beginnings American traders soon succeeded in competing with the English. Many fortunes were made. It was customary to allow masters the privilege of carrying out their own "adventures." Of this privilege their friends took advantage, and many a commission, each constituting an "adventure," was entrusted to the sea-going captains. Mr. Foord cites a few instances such as that of Mr. John R. Tucker, a resident of Salem, who turned over one hundred Spanish dollars to Edward Stanley, master of the *Messenger*, with instructions to invest it at his discretion in foreign commodities. Mr. Tucker's "adventure" brought him $193.57, almost 100 per cent on the investment, according to Mr. Foord.

A complete study of these American "adventures" would add picturesque passages to the history of early national times. The period in which they were undertaken was one in which people took an interest in foreign affairs. Their "adventures," whether modest or considerable, turned their thoughts to far-away places like Canton or Batavia. But the powerful attraction of a continental expanse of land to the west was to outweigh

the influence of maritime enterprise. Now that the day of adjustment between these two attracting forces seems at hand, Mr. Foord's lines fit in as a most timely reminder.

The Nitrate Caves of the South. The U. S. Geological Survey is looking into every report of the occurrence of nitrate and potash, substances which during the war have become even more valuable than formerly. Supposedly rich discoveries have turned out in each case to be of doubtful importance, although some historically interesting information has gained circulation as a result of the Survey's studies. It has been found that a cave in one of the Southern States was worked by the Confederacy during the Civil War for potassium nitrate. The method of extraction was very crude. The cave earth was shoveled into iron pots, where it was treated with water and heated over wood fires to leach out its soluble parts. The liquor was drawn from one pot into another and used for treating fresh material until it became a highly concentrated solution of nitrate salts. It was then drawn off and allowed to cool, whereupon the nitrate crystallized. The remaining liquor was then employed to leach fresh material and the crystals were separated and sacked for use (*U. S. Geol. Survey Press Bull. No. 331*, August, 1917).

Agricultural Meteorology in the United States. A comprehensive summary of the present status of agricultural meteorology in the United States has been presented by Professor J. Warren Smith to the Ohio Academy of Science (*Proc. Ohio Acad. Sci.*, Vol. 6, Pt. 5, 1916, pp. 239-264). On account of the far-reaching effect of climate and weather on crop distribution and production, the scope of agricultural meteorology is wide. Unsuspected relations are found by comparing well-selected climatic maps with agricultural ones. For example, in Wisconsin, most of the cheese factories are where the mean summer temperature is below 70° F., while the creameries are in the regions warmer than 70° F. This distributional aspect is being studied in the preparation of the Atlas of American Agriculture by the Office of Farm Management with the collaboration of the other bureaus of the U. S. Department of Agriculture.

An investigation of the effect of weather on the growth of crops has not been undertaken in so comprehensive a manner. For corn, wheat, and potatoes, Professor Smith has already stated concisely some of the effects of weather on yields. Thus, with July rainfall 2 to 2½ inches, the average yield of the 30,000,000 acres of corn in Missouri, Iowa, Illinois, and Indiana is 23 bushels per acre; but with 2½ to 3 inches, the yield is 33. In other words, in this region, a half inch of July rainfall is worth ten bushels of corn per acre. The period immediately after blossoming, or August 1 to 10 in the middle of the corn belt, is the most critical in the growth of corn: relatively cool, moist weather at this time favors the highest yields. Potatoes in Ohio are affected by July weather more than by that of any other month: relatively cool, wet weather is best. At some other times, dry weather is favorable. For winter wheat, Professor Smith finds little correlation of Ohio yields with the weather of any month except March, when warmth or lack of snow are favorable, and coldness or more than usual snowfall unfavorable. It appears that better yields in Ohio generally follow Januarys with bare ground. The answers to questions raised by these results and to other unexplained weather effects, such as on crop limits, on the work of fertilizers, and on seed-vitality, are left to future study. And for this the foundations are now being laid by Professor Smith as head of the Weather Bureau's new division of agricultural meteorology.

CHARLES F. BROOKS.

The Commercial Prosperity of Porto Rico. The trade relations between the newly created Territory of Porto Rico and the United States have a special interest through their rapid progress, made of late years and particularly since the beginning of the war. One of the most striking aspects of this development is the growing importance of San Juan as a distributing market for the Caribbean, a position in which a naturally favorable location has been supplemented by the establishment of good steamship service with the ports of the Atlantic States. San Juan is only four or five days distant from New York. In 1916 imports into the island from the United States amounted to $41,591,944, a gain of 35 per cent on the figure for 1914. To this increase the demand from Santo Domingo contributed not a little, for the disturbed condition of this island prevented regular shipments direct from the United States. The second outstanding feature of Porto Rican trade development is the great expansion of the sugar industry. Two-thirds of the $68,246,319 representing the 1916 exports to the United States is accounted for by raw sugar, the export value of which more than doubled the figure for 1914. While the higher value is in part due to the increased selling price of sugar the output has also made headway, and it is encouraging to note that the 1917 crop promises to establish a new record (H. F. Kupfer: The New Territory of Porto Rico Unusually Prosperous, *Dun's Rev.: Internatl. Edit.*, July, 1917).

SOUTH AMERICA

Geographical Features of Potato Production in Bolivia. Many important trading towns on the plateaus of Peru and Bolivia have a weekly or annual "fair" for the sale and direct exchange of goods by barter. In such towns one of the most important places is the so-called "potato plaza," where sacks and heaps of potatoes are scattered about. To the stranger the number of varieties of potatoes is truly remarkable, but easily understood when he recalls that the Andean plateau is the ancestral home of the potato. Even in some lofty localities there may be found dozens of wild and inedible varieties. In the Bolivian and Peruvian tablelands and high mountain valleys the potato forms the chief and, in many places, almost the only vegetable food of the highland farmers and shepherds.

There has recently appeared a very instructive report on the Bolivian potato by the President of the Geographical Society of La Paz and recently the recipient of the David Livingstone Centenary Medal of this Society—Señor Manuel Vicente Ballivián (M. V. Ballivián and W. C. Tovar: Noticia histórica y clasificación de la papa de Bolivia, 22 pp., La Paz, 1914). The paper opens with an historical and descriptive account of the cultivation, manner of growth, habitat, uses, and varieties of the potato. In the section on classification it is interesting to note that 184 distinct varieties are listed. The name of each variety is given, the Spanish equivalent, and a brief description of its chief characteristics. There are three colored plates. The descriptive part of the paper gives some highly interesting accounts of the mode of preparation of the chief varieties now used. Perhaps the most striking item relates to the preparation of *chuño* for the caciques and other dignitaries. After being dried in the sun and wind and frozen on the bare ground at night the potatoes are soaked in water for two months, then dried again in the sun, and at last become very white. In relation to this custom one may see a curious sight on the Desaguadero River in western Bolivia. Here and there is a sack of potatoes lying in the shallow water near the bank and tied with a grass rope to a stake driven into the earth. Directly the whistle of the river steamer blows a boy may be seen running at full speed down to the water's edge and hauling on the rope, to see if the wash of the lumbering stern-wheeler has broken loose his submerged sack of potatoes.

The Influence of Weather on Argentine Agriculture. From the economic standpoint Argentina is primarily interesting as a producer of foodstuffs for export. In 1913 over two-thirds of the value of her exports was accounted for by wheat and maize. Argentina is the leading world exporter of the latter and in export of wheat ranks with Russia and the United States. But here as elsewhere the generally speculative nature of agricultural industry makes itself strongly felt: the crop variations are great. The year 1907-08 is remembered for the record wheat harvest, with a production of over 5,250,000 tons and an export of over 3,500,000. In the year 1913-14, with a much greater area under cultivation, the production was little more than 3,000,000 tons, with under 1,000,000 available for export. Fluctations in the corn crop are even more marked. In 1909-10 the harvest amounted to 4,500,000 tons; in the succeeding year to less than 750,000 and in 1914-15 reached the record figure of 8,500,000.

While the locust plague is apprehended as a more or less important agency of destruction, the chief element of variability lies in the climatic irregularities, especially in the recurring periods of drought. The vital importance of the weather in Argentina, felt through its effect on the cereal crops, is well illustrated in the consternation lately caused by the embargo placed on wheat export. The study of Argentine weather, then, assumes a character of practical importance. In advancement of such a study the inauguration of a monthly bulletin by the National Meteorological Office is therefore most welcome (see note in the July *Review*, p. 60). The need of such a report as a complement to the daily weather charts has long been felt, but heretofore funds for the purpose have not been available.

The New Boundary between the Brazilian States of Santa Catharina and Paraná. The long boundary controversy between the states of Santa Catharina and Paraná was settled by an agreement ratified on October 20, 1916, at Rio de Janeiro. Through the courtesy of the National City Bank of New York, the Society is enabled to present the following notice of the revision, the full text of which appeared in São Paulo papers on October 21, 1916. Starting on the Atlantic coast the new line will coincide with the boundary agreed to since 1771 and will follow the course of the Rio Negro to its confluence with the Rio Iguassú. It will there cross the bridge of the São Paulo-Rio Grande Railway and coincide with the tracks of this road as far as the junction with the branch connecting Porto União de Victoria and Palmas. Thence the line

will follow this railway until the Rio de Jangada is attained. From this point the boundary follows the river to its source. Thence it proceeds in a straight line perpendicular to the meridians until it reaches the water-divide. It then strikes west towards the line which connects the sources of the San Antonio and Peperiguassú Rivers. Beyond, it is prolonged to the Argentine frontier.

Through this settlement part of northwestern Santa Catharina is added to the state of Paraná.

EUROPE

The British Canal System. The reconstruction of the New York State waterways, the recent opening of the Marseilles-Rhone canal, the proposed connections between the Danube and the Rhine, Oder and Elbe and other extensive canalization projects contemplated by the Central Powers are evidences of the general revival of interest in transportation by inland waterways (*Commerce Repts.*, 1917, Nos. 69 and 86, 1917; see also the note on the Main-Danube Canal in the *Scott. Geogr. Mag.* for April, 1917). On the Continent, indeed, the revival is not new. In Germany it began in the seventies. In two decades the waterborne traffic of the interior had increased 120 per cent. Like progress was made in Belgium and northern France. The former country in particular owes its great industrial growth to the development of its waterways. Across the North Sea conditions have been different. The British inland waterways have declined progressively from the days of the canal era that began with the industrial revolution and contributed so much towards it (compare B. C. Wallis: Central England during the Nineteenth Century, *Geogr. Rev.*, January, 1917). Since the advent of the railroad in the second quarter of the nineteenth century no new canals have been constructed, except the Manchester Ship Canal, which pertains to a different class. Improvements also have been few, and traffic on the major part of the 4,670 miles of canal and canalized river now existing is negligible. A few years ago the government, aroused by the contrasting conditions on the Continent, appointed the Royal Commission on Canals and Waterways. Its findings, published in 1909, showed, however, that negligence was in part due to physical difficulties. As compared with Continental conditions, at least in the plain of Belgium and northern Germany, engineering obstacles are great. The number of locks on the British canals testify to this. In fact some of the early canals, as those across the Pennines, show engineering feats of no mean order. Moreover the present condition of the waterways is adverse to the employment of mechanical traction, an improvement that has done much to increase the usefulness of the Continental waterways, and another limiting factor is the inadequate or irregular water supply that proves serious in some of the Midland systems, notably the Trent.

Today the stimulation given to waterborne traffic by the congestion on the railways renews the problem of their improvement. That a better utilization may well be effected under the present governmental control is the opinion expressed in the *Engineering Supplement of the London Times* (issue of February 23, 1917, with waterway map of Great Britain, 1:1,900,000, showing (1) canals and navigable rivers, (2) derelict canals, and (3) canals converted into, or sites used for railroads), which instances the successful operation of such canals as the Aire-Calder, the important system connecting the Yorkshire woolen towns with the Humber. In a later issue of the *Engineering Supplement* (April 27, 1917) the engineering problems are considered in an optimistic light.

The Severe Winter of 1917 in Scandinavia. Charles Rabot, in discussing the winter of 1917 in Scandinavia (L'hiver 1917 dans la Scandinavie, *La Nature*, April 21, 1917), points to the way in which extraordinary ice conditions hampered the Germans. For about two months, railway ferriage between Sweden and Denmark was frequently obstructed; and for two weeks early in February it stopped entirely. Other ships were caught in the ice or had to set back. In fact, one captain reported that there were two hundred ships stuck in the Skager Rak early in February; and Danish fishermen said that 33 German submarines were blocked in the ice of the Kattegat on February 7. Moving ice exploded many mines. This ice condition, which was the most severe since 1895, was the result of an extraordinary period of cold weather in southern Scandinavia, northern France and Germany lasting from late December till the middle of March. At Christiania, the temperature from December 23 to February 9 did not rise above freezing—a duration unique in the 56 years of observations. January, with a mean of –10.9° C., was 6.9° C. below normal—the coldest on record, although the absolute minima were not extraordinary. In Sweden, however, a temperature of –55° C. was observed at Vuenatjviken, a meteorological station at an altitude of 500 meters in Norrbotten, northern Sweden. There were some extraordinary snowstorms: one near Christiania on February 2-3 caused a disastrous avalanche. Another over all Norway

ten days later was so severe in Vardö that a woman was lost in the middle of the village; and houses were practically snowed in. On March 14 northern Denmark suffered the worst snowstorm in forty-five years, one which suspended railroad traffic in north Jutland.

The undersigned may suggest the following by way of explanation. In the seven weeks from February 9 to March 28, 1916, the temperature of the surface water passing through the Florida Straits averaged 23° C.—about 0.5° C. below normal. In the course of ten to eleven months some of this water arrived in the Norwegian Sea; and, being cooler than usual, weakened the Iceland cyclone. This allowed a westward extension of the Eurasian anticyclone with its attendant cold weather. CHARLES F. BROOKS.

ASIA

Recent Developments of the Bagdad Railway. A history of the negotiations leading to the construction of the Bagdad railway, together with an account of the state of construction, is given by H. Charles Woods in a recent article (The Baghdad Railway and Its Tributaries, *Geogr. Journ.*, July, 1917). The report of the completion of the tunnels in the mountainous sections connecting Anatolia with Syria is now confirmed. Through connection between Constantinople and Aleppo is therefore possible—a fact which is of interest because it adds greatly to the strength of the Turco-German position in Turkey.

Regarding the future of the line Mr. Woods justly assumes that the subject is one which is hard to forecast at the present time. The only certainty lies in the fact that the line will benefit the development of Asiatic Turkey's resources. The details of its operation depend entirely upon the international situation at the advent of peace. The question of internationalizing the line is one which will then come up for discussion. By its geographical position Turkey is a land in which internal problems are magnified to the point of assuming international importance. Mr. Woods gives numerical evidence of this fact by recalling that before the war mails conveyed from London to Bombay by the usual sea route required thirteen or fourteen days, whereas with the completion of the Bagdad line the time of transit will be reduced to between nine and ten days.

Additional Notes on the Population Density of Japan. In abstracting a short article by the writer in the November, 1916, *Review* on "The Distribution of People in Japan in 1913," the *Annales de Géographie* (March 15, 1917, pp. 151-152), in their usual admirable manner, present additional facts of interest, which it is desired herewith to credit to their proper source, as the abstract itself modestly gives no hint as to their authorship.

Although the high population density of the majority of the prefectures in the most densely populated zone of Japan is generally due to the presence of urban centers, the prefecture of Takamatsu, on the island of Shikoku, has 425 inhabitants to the square kilometer without the help of any important city. This is in the southern belt of dense population, which coincides with the so-called "median line" in the physical structure of the islands "determined by the work of Harada, Koto, Naumann, and formed of a chain of tectonic valleys and zones of sinking, interrupted here and there by gulfs, recent sediments and volcanic deposits. This line, according to Harada, marks structurally the limit between the outer coast of Japan, which is regularly folded and poor in volcanic rocks, and the coast inside, along the Sea of Japan, which abounds in *graben* and eruptive phenomena and forms a region of faulted arches." The great density of population of the empire in spite of its generally rugged surface is only rendered possible by the cultivation of rice, and Yezo was so long neglected by the Japanese as to seem still uninhabited among the dense populations of the empire because it was unsuited to grow rice. MARK JEFFERSON.

POLAR REGIONS

Safe Return of the Members of the Crocker Land Expedition, and Resurvey of the Southeastern Coast of Ellesmere Island. On August 26 the relief ship *Neptune*, whose departure was announced in the July *Review* (p. 62), reached Sydney, Cape Breton, with the members of the Crocker Land Expedition. All were in good health and have since reached their final destination in the United States, MacMillan and Hovey arriving in New York some time ago. The trip from Etah took twenty-two days. Southerly winds had packed Smith Sound and Melville Bay with drift ice, and the ship was leaking badly on its arrival as a result of the constant hammering of the ice.

In the same telegram in which MacMillan announced the safe return of the party (published in the daily press of August 28) he described a trip made last spring along the southeastern coast of Ellesmere Island. The section covered extends from Cape

Sabine (78¾° N.) to Clarence Head (76⅔° N.). This stretch of coast was surveyed roughly by Inglefield in 1852 (Correspondence Relating to Arctic Expeditions, 88 pp., *British Blue Book No. 82*, ordered to be printed December 20, 1852; reference on pp. 35-39 and map facing p 40), Kane in 1854 (E. K. Kane: Arctic Explorations: The Second Grinnell Expedition, etc., 2 vols., 1856, map facing p. 8 in Vol. 2), and, more accurately, by Hayes in 1861 (I. I. Hayes: Physical Observations in the Arctic Seas, with map, 1:1,200,000, *Smithsonian Contr. to Knowledge 196*, in Vol. 15, 1867). But all these delineations were based on surveys made from the decks of vessels, often by means of distant sights, as ice prevented a close approach to shore. They are thus naturally not always accurate as to details. MacMillan's sledge trip has corrected a number of these inaccuracies.

Starting from Etah (on the Greenland coast, 78⅛° N.) on March 26, 1917, with three Eskimos, Smith Sound was crossed in four days. On the opposite shore open water forced the party to go south by way of Rice Strait, an interior channel separating Pim Island from the main body of Ellesmere Island. Blocked at Cape Herschel, a little farther south, MacMillan turned inland again and cut across the intervening promontory to Baird Inlet (78½° N.). Here, at Eskimo Point, at the northern entrance to the inlet, the walls of three stone houses and the remains of a boat were found on the site of the first encampment of Greely's starving party in 1883. Continuing south, MacMillan was completely stopped at Cape Isabella (78⅛° N.) by open water and an impassable ice-foot. Before turning back he searched the cape carefully and was fortunate in finding records left by Sir George Nares of the British expedition of 1876, also mail for H. M. S. *Discovery* and *Alert*, left by Sir Allan Young of the *Pandora*. They were legible and in fairly good condition. On the return to Etah, Baird Inlet was mapped.

Starting again from Etah on May 3, ice conditions were found unchanged. An inland route was therefore chosen leading across Cadogan Inlet to Paget Point (78° 10′ N.). South of this point there was sea ice and traveling was easier. MacMillan notes various new features between here and Clarence Head. Between Paget Point and Cape Faraday (77° 40′ N.) a very large glacier was discovered and named the American Museum Glacier. It is formed by the ice cap pushing over the edge of the land into the sea and is only second in size to its analogue, Humboldt Glacier on the coast of Greenland between 79° and 80° N.

The other discoveries reported relate to the existence of two islands, one south of Paget Point, the other in Talbot Inlet, just south of Cape Faraday, and the non-existence of Sonders Island (77° 10′ N.). Throughout this region glacial activity has increased since the middle of the nineteenth century. The land is fairly buried in ice, which flows over and around the headlands and fills all the fiords.

On his return MacMillan camped in Peary's old hut at Cape Sabine and visited the second camp of Greely's starving party on the north shore of the cape and made a survey and took photographs of the locality. Throughout this sledge journey good sights for longitude, latitude, and azimuth were obtained at all salient points.

HUMAN GEOGRAPHY

The Cause of Pellagra, Disease of Mountain Countries. In 1906 public interest became aroused in a mysterious scourge that had long been known in Europe and that appeared to have been transplanted to America. By 1911 the epidemic had affected 30,000 people in an area including all but nine states in the Union, according to a paper by Benjamin Brooks (*Illustrated World*, January, 1916, pp. 642-646). The paper cited is accompanied by a map showing the distribution of the disease in America, and it is pointed out that there is a striking relationship between such distribution and the distribution of the older and more deeply eroded mountain ranges and the drainage basins of rivers originating in these mountains. The application of the words "new" and "old" are, however, unfortunately made, and some other factor than age is responsible for the distribution of the disease. The map in question cannot be commended in any scientific study of the disease. (For a similar map, of scientific worth, see map showing the relation of goiter in Europe to the underlying geological formation, in Berghaus' Physikalischer Atlas, 1892, Pl. 64.)

Experiments made on victims of the disease seem to show that it is caused by the colloidal silica in the food, and a cure has been found in sodium citrate. It is suggested that waterworks engineers introduce the proper alkali into the water systems of large towns. The prevention of pellagra has become more difficult in country localities, but broken limestone in the bottom of a cistern and the exclusion of surface drainage from ordinary wells are suggested as remedial measures. The interesting comment is made that in France, where the same land is plowed each year and where cultivations extends back over a much longer period, pellagra, once widely prevalent, is now disappearing.

GEOGRAPHICAL PUBLICATIONS

(Reviews and Titles of Books, Papers, and Maps)

For key to classification see "Explanatory Note" in Vol. II, pp. 77-81

NORTH AMERICA

CANADA

Maritime Provinces, Newfoundland

HOWLEY, J. P. **The Beothucks, or Red Indians: The aboriginal inhabitants of Newfoundland.** xx and 348 pp.; maps, diagrs., ills., bibliogr., index. University Press, Cambridge (Engl.), 1915. $6.50. 12 x 9½.

Mr. Howley, who for forty years was connected with the Geological Survey of Newfoundland—begun by the late Alexander Murray, F.G.S.,—was attracted to the subject of the aboriginal inhabitants when the survey of the valley of the Exploits River was started in 1868. In this valley many relics of the Red Indians were found, and traces at that time of their deer fences were in evidence (see also Mr. Babcock's paper on Markland in this number of the *Review*, pp. 314-315). Time and scanty records have much handicapped Mr. Howley in his work, but he has most industriously prosecuted his search for evidences of the habits, vocabulary, and origin of this long-extinct people and has given us the result of his labors in a most interesting volume. In the preface he says that he has used his best endeavors "to preserve from oblivion the principal facts relating to this interesting but unfortunate section of the human family."

In his account of the Beothucks, Mr. Howley quotes the narratives of the early voyagers who visited the New World and who recorded their intercourse with and their capture of a few of the natives, whom they carried to Europe. Some of the narratives cannot be depended upon as relating to Newfoundland. For instance, Richard Edens, in 1555, and Fabian, another chronicler of contemporary date, mention that Cabot brought to England three of the natives, "which he presented to the King (Henry VII) in the fourteenth year of his reign," viz. 1499. None of these writers is considered reliable, as the information they published was mostly obtained from Sebastian Cabot's statements, which, it is generally conceded, were not truthful. As Mr. Howley says, "the accounts of the Cabot discoveries are of such a meager description, and are, moreover, so conflicting and unreliable in most respects that we can cull very little from them that is really trustworthy; consequently their references to the people met with on these shores might apply to any of the inhabitants from Cape Chidley to Florida." The landfall of Cabot is a much-disputed point, and as it is not certain that he ever saw Newfoundland any testimony of his respecting the aborigines is of no value.

In Gaspar de Cortereal's account of his voyage in 1500, it is related that a number of the Indians were brought to Lisbon. The description given of them shows that they must have been Eskimos and not Indians. In his second voyage he was lost. During the sixteenth century it is recorded that natives from North America were brought to England and some to France. In the records of the voyages of Jacques Cartier, 1534-1535, we get the first reliable description of the Beothucks, or natives of Newfoundland. From this time onwards, it appears that very little attempt was made to open up an amicable intercourse with the aborigines, which was no doubt due in part to their timidity and to the ruthlessness of the Europeans who visited these shores and who shot down these people at sight. Hence it is that we have no certain knowledge of their origin. For over three hundred years they were known to Europeans as inhabiting Newfoundland. They were pictured as a people of good stature and well made; of a light color, and not darker than some French people. They broiled their meat and fish, which they were in the habit of preserving by drying, and they clothed themselves with skins. Here on the nearest point of America to Europe, in the oldest of England's colonies, has lived, flourished, and become extinct in its own orbit a primitive nation.

Was this tribe of Indians related to those tribes which occupied the neighboring continent or was it *sui generis?* Mr. Howley speaks of the theories advanced by early writers that these Indians were descendants of the Norsemen (see Mr. Babcock's paper, above, pp. 314-315), who, tradition asserts, discovered America in the tenth century; but

on an examination of the vocabulary, gathered from some of the Beothucks who were brought to St. John's in the early part of the nineteenth century, when an attempt was made to hold friendly intercourse with them, it has been held that such could not be the case. Some authorities assert that they were decidedly of Algonquin stock and were related to the Pawtuckets and Pequots of New England. Professor G. Latham of the Anthropological Society of Great Britain gives it as his opinion that they were a separate branch of the Algonquins, whilst the late Albert S. Gatschet of the Bureau of American Ethnology of Washington, who took infinite pains in comparing the Beothuck vocabulary with that of the many dialects of the Indian tribes of the mainland, was decidedly of the opinion that the language possesses no real affinity with any of these, that it is a mistake to suppose they were Algonquins, or yet Chippewans.

From the evidence compiled by Mr. Howley it is impossible to form any definite conclusion as to the origin of the Beothucks, yet there can be little doubt that they must have come originally from the mainland of America and by way of the narrow Straits of Belle Isle. When they came to Newfoundland can only be guessed at, but it must have been certainly many years before the discovery of America. That they existed in the island up to 1827 and that since then no trace of them can be found is chronicled by Mr. Howley, who is of opinion that they migrated to the Labrador coast about that time.

H. W. Le Messurier.

Ganong, W. F. **An organization of the scientific investigation of the Indian place-nomenclature of the Maritime Provinces of Canada.** *Trans. Roy. Soc. of Canada,* Ser. 3, Vol. 9, 1915, pp. 375-448.

G[arnier], A., edit. **Relation d'un naufrage sur l'Ile Royale, 1780-1781.** *Bull. Soc. de Géogr. de Québec,* Vol. 10, 1916, No. 3, pp. 154-167; No. 4, pp. 214-229. [This narration of a shipwreck on Cape Breton Isle (Ile Royale) during the winter of 1780-81 is extracted from the journal of Ensign M. S. W. Prenties. The relation was first published in London, 1782.]

McIntosh, D. S. **A study of the Cow Bay beaches.** Maps, ills. *Proc. and Trans. Nova Scotian Inst. of Sci.,* Vol. 14, Part II, 1915-16, pp. 109-119. Halifax. [The author does not find any evidence pointing to recent elevation of the coast line. See reference in Professor D. W. Johnson's paper "Is the Atlantic Coast Sinking?" in the February, 1917, *Review,* p. 137.]

MacKay, A. H. **The phenology of Nova Scotia:** (1) **1912;** (2) **1913;** (3) **1914;** (4) **1915.** Maps. *Proc. and Trans. Nova Scotian Inst. of Sci.,* Vol. 13, 1910-14, pp. 250-258; pp. 347-355; Vol. 14, Part I, pp. 57-65; Part II, pp. 133-140. Halifax. [Notes on the date of the advent of spring as indicated by the budding of characteristic plants, etc.]

Morris, Daniel. **Newfoundland and its forest resources.** *Scottish Geogr. Mag.,* Vol. 32, 1916, No. 8, pp. 352-366.

—— **Nova Scotia, Province of: Annual report of the mines: 1915,** 181 pp., diagrs.; **1916,** 174 pp., diagrs., ills. Dept. of Public Works and Mines, Halifax, 1916 and 1917.

Wright, W. J. **Moncton map-area, New Brunswick.** *Summary Rept. Geol. Survey of Canada for 1915,* pp. 179-185. Ottawa, 1916.

—— ***Nova Scotia, Province of, Map 150A. Ponhook Lake sheet No. 72.*** 1:63,360. Geological Survey, Dept. of Mines, Ottawa, 1916.

United States

Western States

Beadle, J. B. **Progress in reclamation of arid lands in the western United States.** Map, ills. *Ann. Rept. Smithsonian Inst. for 1915,* pp. 467-488. Washington, D. C., 1916.

The progress that has been made in the transformation of the arid west and in the creation of opportunities for homes for citizens is summarized in this article. Mr. Beadle has been in a position to watch the changes and to select for description the salient points in the great works which have been initiated under the terms of the Reclamation Act of June 17, 1902. He has outlined the principal engineering features and has given large consideration to the geographic or topographic features which have contributed to the practicability of the various undertakings. Especial attention has been given to the factors which have made it possible for settlers to obtain a permanent foothold on the soil.

The amount of money derived from the proceeds of the disposition of public lands and utilized in the building of works for reclaiming the arid lands totals up to nearly $100,000,000. With this sum there have been constructed some of the largest works for conservation of water by storage that have ever been undertaken, such, for example, as the Roosevelt Dam in Arizona; the Arrowrock Dam in Idaho, 350 feet in height, the highest in the world; the Shoshone Dam in Wyoming; and the Elephant Butte Dam in New Mexico. In all a hundred dams, large and small, have been built, supplying water to nearly 10,000 miles of irrigating canals and distributaries. There have been built also 25 tunnels, through which some of these canals run, and nearly 65,000 canal structures, big and little. But greater than the engineering work is the transformation of over a million acres of desert into productive farms, and the fact that in the past year crop values of nearly $20,000,000 have already been realized, although the irrigated lands themselves have not yet been wholly subdued and brought under cultivation.

Climate, soil, and adequate water supply contribute to success, but after all the man himself is the essential item. With the true pioneering spirit, willing to endure privations, to work hard, to practice thrift, to use his brains, and to persist in good works, the settler has every reason to look forward to a comfortable and prosperous home. Experience has shown that there is probably no occupation in which the average man can be more assured of success. For one reason, in these new communities he is on a par with his neighbors. All are struggling, all wear old clothes, and all are forced to put back into the farm and home every cent that can be spared. Thrift is enforced, and thus, although constantly in debt and sometimes almost in want, the owner of a farm finds his holding increasing in value as the soil is intelligently tilled.

The individual counts for far more in these sparsely settled western states than in the east, and the farmers on these reclaimed lands may well feel a pride that they are a larger factor in the state and in the nation than they possibly could be in the densely crowded eastern section of the country.

F. H. NEWELL.

JOHNSON, CLIFTON. **Highways and byways of the Pacific Coast.** xiii and 323 pp.; ills. (American Highways and Byways Ser.) The Macmillan Co., New York, 1908; new edit., 1913. 8 x 5.

The author has "wandered much on rural byways and lodged most of the time at village hotels or in rustic houses" searching for "the typical and the picturesque." These qualities have been sought not only in the peculiarities of Pacific Coast scenery and climate but also, and most assiduously, in human types and in personalities. The first chapter, written in an informal and chatty style, gives interesting comments on the approaches to the Grand Canyon of Arizona and an accurate and charming word-picture of the soft tones of the successive strata and the wonderful changes of tints in the varying lights and shadows.

The reader must not expect to get a complete geographical account of any portion of the west, for the author's object is the enjoyment not merely of natural scenery but also of the reaction to a new environment of both settler and tramp. The itinerary carries one from Arizona to San Diego and southern California, thence northward through the San Joaquin Valley to the Yosemite and San Francisco, but the narrative is frequently interrupted by detailed accounts of trivialities touching human life. After a side trip to Nevada and the mines the journey continues northward again past Shasta to Oregon and the Northwest. Each chapter closes with notes for the traveler, and everywhere the author's camera has caught typical views which supplement the text.

RULIFF S. HOLWAY.

ABEL, A. H. **The journal of John Greiner.** *Old Santa Fe*, Vol. 3, 1916, No. 11, pp. 189-243. [Duties of a U. S. acting Superintendent of Indian Affairs at Santa Fe, New Mexico, in 1852.]

ATWOOD, W. W. **The physiographic conditions at Butte, Montana, and Bingham Canyon, Utah, when the copper ores in these districts were enriched.** Maps, diagrs., ills. *Econ. Geol.*, Vol. 11, 1916, No. 8, pp. 697-740.

AVERS, H. G., AND G. D. COWIE. **Precise leveling from Reno to Las Vegas, Nev., and from Tonopah Junction, Nev., to Laws, Cal.** 49 pp.; maps, diagr. *U. S. Coast and Geodetic Survey Serial No. 49.* Washington, D. C., 1916.

BRENNA, PAULO. **Interessi dell'emigrazione italiana negli Stati di Washington, Oregon, Idaho, e Montana.** *Boll. della Emigrazione*, Vol. 15, 1916, No. 7, pp. 5-42. R. Commissariato della Emigrazione, Rome.

DARTON, N. H. **Geology and underground water of Luna County, New Mexico.**

188 pp.; maps, diagrs., ills., index. *U. S. Geol. Survey Bull. 618.* Washington, D. C., 1916.

FREEMAN, O. W. **Geographic influences affecting distribution of population and character of industries in Montana.** 7 pp. Reprinted from *Inter-Mountain Educator,* January, 1916. [Abstracted in the *Review,* Vol. 1, 1916, p. 217.]

GARVER, F. H. **Montana as a field for historical research.** *Proc. Mississippi Valley Hist. Assoc. for the Year 1913-14,* Vol. 7, pp. 98-112. [Desiderata named include discussion of the geology, physical geography, early roads and trails, exploration, fur trade, mining, water and land transportation of the state.]

HULL, DOROTHY. **Castano de Sosa's expedition to New Mexico in 1590.** Ills. *Old Santa Fe,* Vol. 3, 1916, No. 12, pp. 307-332.

JUDSON, K. B., edit. **Dr. John McLoughlin's last letter to the Hudson's Bay Company, as chief factor, in charge at Fort Vancouver, 1845.** *Amer. Hist. Rev.,* Vol. 21, 1915, No. 1, pp. 104-134.

MCEWEN, G. F. **Summary and interpretation of the hydrographic observations made by the Scripps Institution for Biological Research of the University of California, 1908 to 1915.** Maps, diagrs. *Univ. of California Publs. in Zoology,* Vol. 15, 1916, No. 3, pp. 255-356. [Discusses the phenomenon of cold water along the Californian coast and the hypothesis of upwelling of deep cold water. For an abstract of an earlier article on the same subject by Dr. McEwen see note on "Ocean Temperatures along the West Coast of North America," *Bull. Amer. Geogr. Soc.,* Vol. 45, 1913, pp. 452-453.]

MEANY, E. S. **First American settlement on Puget Sound.** *Washington Hist. Quart.,* Vol. 7, 1916, No. 2, pp. 136-143.

MEINZER, O. E. **Artesian water for irrigation in Little Bitterroot Valley, Montana.** (Contributions to the Hydrology of the United States, 1916.) Maps, diagrs., ills. *U. S. Geol. Survey Water-Supply Paper 400-B,* pp. 9-37. Washington, D. C., 1916.

QUAIFE, M. M. **Notes and documents: Some new-found records of the Lewis and Clark Expedition.** *Mississippi Valley Hist. Rev.,* Vol. 2, 1915, No. 1, pp. 106-124.

RAMALEY, FRANCIS. **Dry grassland of a high mountain park in northern Colorado.** Ills. *Plant World,* Vol. 19, 1916, No. 9, pp. 249-270.

REED, W. G. **Report of the Meteorological Station at Berkeley, California, for the year ending June 30, 1915.** Diagrs. *Univ. of California Publs. in Geogr.,* Vol. 1, 1917, No. 10, pp. 441-504. [A note on the summer fog ascribes this phenomenon "probably" to mixture. Figure 6 is a clear and concise graphic presentation of the facts regarding the probability and the percentage of days with and without measurable precipitation. Figure 10 shows the precipitation of 1914-15 by rainfall days. A study of rainfalls by cyclones, a most important subject in our latitudes, is included.—R. DE C. W.]

—— **Seattle, The public port utilities in.** 23 pp.; map, ills. *Port of Seattle Commission Bull. No. 8.* Seattle, [1916].

TERMAAT, M. I. **Cities of northern Puget Sound.** *Journ. of Geogr.,* Vol. 14, 1915-16, No. 9, pp. 368-369.

—— **Washington number.** Maps. *Journ. of Geogr.,* Vol. 14, 1915-16, No. 9, pp. 309-372. [This series of articles on the physical geography, the resources, and development of Washington includes a paper of special interest entitled "Some Geographic Influences of Eastern Washington in Relation to Agriculture" by A. J. Lechner. The author points out that the variations in agriculture in various sections of the eastern portion of the state are very marked. He finds rainfall and soil to be the dominant controls, topography and altitude having secondary influences.]

EUROPE

GENERAL

EVERSLEY, LORD. **The partitions of Poland.** 328 pp.; maps, ills., index. Dodd, Mead and Company, New York, 1915. $2.50. 9 x 5½.

NALKOWSKI, W. **Poland as a geographical entity.** With a preface by James Fairgrieve. 63 pp.; maps. Published for the Polish Information Committee by George Allen & Unwin Ltd., London, 1917. 8½ x 5½.

ORVIS, J. S. **A brief history of Poland.** xix and 359 pp.; maps, bibliogr., index. Houghton Mifflin Company, Boston, 1916. $1.50. 8 x 5.

Sympathetic attention is directed at the present moment toward Poland in view of the promises of the restoration of the country's sovereignty made by both belligerent

parties. All three of these books offer information intended to enlighten readers on the historical basis of Poland's right to independence. From Lord Eversley's book it will be easy to understand how deeply Prussia was involved in the partition of Poland. Miss Orvis' work demonstrates the faulty side of the German pledge of November 5, 1916, granting Polish autonomy. This grant was made at Russia's sole expense and with the exclusion of Posen and Galicia. It therefore deprives Poland of the great cities which have been centers of national life for the last one thousand years.

For a clear description of the country Nalkowski's essay is of real value. It errs, however, on a side toward which Polish scientists have tended during the past two years with an ease altogether unwarranted by facts. A scientific delimitation of Poland's national area must primarily take into account the individuality of the Polish plain. The eastern boundary at the time of the First Partition or the widest extension of Polish frontiers beyond the Dnieper into Russia proper are mere records of military expansion. As such they are open to criticism analogous to that which is invoked to repudiate retention of German or Russian frontiers on Polish territory. The percentages of Polish population indicated on the map accompanying this work carry far greater significance.

OPPERMANN, EDMUND. **Europa (ohne Deutschland und Alpenländer).** (Series: Präparationen für den geographischen Unterricht, Vol. 1). 362 pp.; ills., index. Julius Klinkhardt, Leipzig, 1913. Mk. 5.80. 10 x 6½.

This is a book written by a school inspector in Brunswick, not a doctor, not claiming to be a geographer, but a book that many a geographic doctor might envy for its simplicity and usefulness.

It contains the items most essential to be taught in school geography classes about most European countries. Germany and the Alpine countries are omitted. The material is good, fresh, and modern. Any teacher who has time would prepare his own material, but time is just what most of them have not. American teachers who are not well read on geographic literature, especially the German books, could not do better than use Oppermann until they come to know the original works. For he goes to admirable original sources, largely unknown in America, for his material. A clever introduction "to arouse interest" is usually prefixed and then follow classified materials, briefly stated, but not so barely as to be uninteresting. It is a very useful volume.

MARK JEFFERSON.

ANNONI, A. M. **Problemi demografici.** *L'Esplorazione Commerc.*, Vol. 31, 1916, No. 4, pp. 135-137.

CASSI, GELLIO. **La geografia come causa nell'attuale conflitto europeo.** *La Geogr.*, Vol. 4, 1916, No. 4-7, pp. 158-164. Novara.

—— **Crops in the warring countries.** *The Nation*, No. 2663, Vol. 103, 1916, p. 29.

HARMS, PAUL. **Landmacht gegen Seemacht.** Map. *Berliner Tageblatt: Wochenausgabe*, No. 52, Vol. 4, 1915, pp. 1-2. [Abstracted under the title of "Land Versus Sea in the War" in the July, 1916, *Review*, pp. 63-64.]

HILDEBRANDSSON, H. H. **On the so-called change in European climate during historic times.** *Monthly Weather Rev.*, Vol. 44, 1916, No. 6, pp. 344-352. [Abstracted in the December, 1916, *Geogr. Rev.*, Vol. 2, p. 468.]

METHORST, H. W. **Etat de la population (Europe).** viii and 166 pp. Annuaire Internatl. de Statistique, publié par l'Office Permanent de l'Institut International de Statistique. Van Stockum & Fils, La Haye, 1916.

NATALE, GIUSEPPE. **Sulla mancata espugnazione di Cattaro e dei Dardanelli, e sulla necessità, per l'Italia, di possedere parte della costa orientale adriatica.** Diagrs. *Riv. Militare Italiana*, Vol. 61, 1916, No. 7, pp. 854-866.

NAUMANN, FRIEDRICH. **Central Europe.** Translated by Christabel M. Meredith, with an introduction by W. J. Ashley. xix and 354 pp.; bibliogr., index. P. S. King & Son, Ltd., London, 1916. 7s. 6d. 9 x 6. [Mainly politico-economic.]

RIDSDALE, P. S. **Shot, shell and soldiers devastate forests.** Ills. *Amer. Forestry*, No. 270, Vol. 22, 1916, pp. 333-340. [On the devastation of forests in the European war zone.]

DARDANO, ACHILLE, AND L. F. DE MAGISTRIS, edits. ***Atlante della nostra guerra.*** 60 pages of text (illustrated) and 16 maps. Istituto Geografico de Agostini, Novara, 1916. [An excellent atlas containing political, topographic, and ethnographic maps dealing with the European War, with special emphasis on the Austro-Italian boundary region. This section is shown topographically on six maps in 1:250,000, with altitude tints, re-

prints of the admirable map published by the Italian Touring Club. A critical feature of the large-scale ethnographic map of the Trentino (Pl. 8) is the omission of racial coloring from the mountain heights, the valleys, as the only inhabited lands in this region, alone being colored. The German area, usually indicated as an uninterrupted mass north of the Ortler-Dolomite Alps axis, thus dwindles to the strips representing the upper Etsch and Eisack valleys, the Pustertal and the Passeiertal. The "natural geographical boundary" of Italy is shown on the appropriate maps.]

—— [*France, Northeast, and southwest Belgium, map showing battle front, and described as "Map of the British Battle Front": no title on map.*] 1 in. to 4 mi. (1:253,440). G. W. Bacon & Co., London, 1916.

AFRICA

General

RECLUS, ONÉSIME, edit. **Grande Géographie Bong illustrée: Les pays et les peuples: Vol. 4 [Africa].** 406 pp.; maps, diagrs., ills. PAUL PELET: **Afrique du Nord (Algérie, Tunisie, Maroc),** pp. 3-74; HENRI BUSSON: **L'Ouest Africain,** pp. 77-156; A. CABATON: **Le Nord-Est Africain,** pp. 159-226; M. CHESNEAU: **Afrique Australe,** pp. 229-322; HENRI FROIDEVAUX: **Les iles africaines de la Mer des Indes,** pp. 325-342; HENRI FROIDEVAUX: **Les terres du Pacifique,** pp. 345-397. Bong & Cie, Paris, 1914. 15 x 12.

This volume is one of five large volumes describing the countries and peoples of the earth, produced under the direction of Onésime Reclus. Africa occupies seven-eighths of the book, and very summary treatment is given to the "Pacific lands," under which term are included Australasia and Oceania and the Philippines. The authors are well known as writers on geography.

The book is a sumptuous product. Its illustrations, halftones, and plates in colors are numerous and educative. Every photograph tells something worth knowing. The maps are in the best style of French cartography. There are 15 large maps in colors and 100 maps and plans in the text. The majority of the large maps are in physical coloring with hachures; being on scales larger than usually available in this important manner of representation (most of Africa 1:8,000,000, Atlas countries, 1:2,500,000), they are especially valuable. Many of the text-maps are black-and-white insets that show surface forms most effectively.

The narrative is permeated with scientific spirit and good geography that is adapted to the needs of any intelligent reader. But we miss a chapter giving a general treatment of the continent. Coast lines and their significance are treated by countries; but what is the effect upon Africa of the fact that, while it is nearly three times as large as Europe, it has only 19,000 miles of coast line, while Europe has 23,000? Surely a book on Africa should make it clear that the continent is less approachable from the sea than any other excepting Antarctica; and we also miss other broad characterizations of Africa as a whole that really have vital relation to the description of parts of it.

The book deals with the face of Africa as it now appears. It would interest many to be told something about how we are able to draw so complete a picture. Take the Niger River, known vaguely to the ancients before the Christian era. A hundred and one years ago last July Captain Tuckey and twelve of his men died of fever on the banks of the Congo, believing that they were on the lower Niger; and geographers, for years after, supposed this was true. A few lines would tell why there was a Niger problem and how it was solved. The book mentions the "Niger problem" and says Clapperton solved it; but it was Lander who threaded the delta, reached the sea, and received the first award of the Royal Medal of the Royal Geographical Society for solving the Niger problem.

Another incident may be mentioned here, not in criticism, but to show what interesting side lights may be thrown upon the Africa of today by a casual appeal to history. While the "Island of Meroë" appears on the maps, it is not mentioned in the text of this book. This name commemorates an interesting discovery made by the Greeks before the time of Christ. The Greeks said there was an enormous area of land in Africa that was entirely surrounded by water. This was almost but not quite true. We can easily trace their "island" on a map. Start at Lake Tana in Abyssinia. Follow the Blue Nile, which emerges from the lake, south and west to the White Nile; follow the White Nile north to the Atbara River; then follow the Atbara to its source, which a good map will show a little to the northwest of Lake Tana; and also a tiny tributary of the lake that rises only two or three miles from the Atbara. Nature did not quite complete the island.

The book most admirably performs its task of showing the various countries and

their peoples, especially in their utilitarian aspects as we know them today. There is, of course, an occasional statement that might be improved. In treating the *sudd* in the Upper Nile as a great obstruction to navigation the book fails to mention another serious evil that the barrage inflicts. An enormous quantity of water, held up by this obstruction, evaporates, while Egypt needs every drop she can get not only for irrigation but also for the manufacturing enterprises which it is hoped to establish. British engineers were planning before the war to open and maintain an uninterrupted channel.

The interest of the French in Africa accounts for the space devoted to that continent. Nevertheless the allotment of 30 pages to Australia and New Zealand as compared with 350 to Africa seems somewhat out of proportion. However, in this brief space, the essentials of Australasian geography are brought out. The reason given (p. 389) for the inclusion of the Philippines in Australasia is flimsy. CYRUS C. ADAMS.

HUFFNAGEL, G. E. **Trans-Afrikaansche spoorwegproblemen.** Maps. *Tijdschr. voor Econ. Geogr.*, Vol. 7, 1916, No. 9, pp. 441-448; No. 10, pp. 471-478.

JOHNSTON, H. H. **The Portuguese and their early knowledge of central African geography.** *Geogr. Journ.*, Vol. 47, 1916, No. 3, pp. 210-212.

MARTEL, E. A. **Les colonies portugaises.** Maps, ills. *La Nature*, No. 2230, 1916, June 24, pp. 401-406.

NICOLA, ANGELO. **L'Italia ed il futuro equilibrio africano.** Maps. *L'Esplorazione Commerc.*, Vol. 31, 1916, No. 3, pp. 81-91; No. 4, pp. 126-135.

O'LEARY, DELACY. **Characteristics of the Hamitic languages.** 46 pp.; bibliogr. John Wright & Sons, Ltd., Bristol, 1915(?). 7½ x 5.

PHYSICAL GEOGRAPHY

GEOLOGY AND GEOMORPHOLOGY

DARTON, N. H. **Explosion craters.** Maps, diagrs., ills. *Scientific Monthly*, Vol. 3, 1916, No. 5, pp. 417-430.

Explosion craters are holes of volcanic origin occurring on plains instead of on volcanic peaks. They have no connection with lava outflows but are rimmed with fragmental volcanic material. A study is here made of the group of such craters near Orizaba Peak, not far from the city of Mexico, of several in north-western Sonora near the international boundary, and of some in Arizona. Among the latter is Crater Mound, or Coon Butte, as it was formerly named, called by the author one of the greatest enigmas in nature. The idea has been advanced that it was caused by the impact of a mass of meteoric iron from 50 to 100 feet in diameter, but this view has not yet been substantiated by evidence of the rocks or by a local study of the magnetic declination. Without expressing an opinion as to this hypothesis Mr. Darton points out the similarity of this crater to others of undoubtedly explosive origin, including not only those in Mexico and the southwestern United States, but also those in the valley of the Rhine, in France, Italy, Madagascar, and India. A photograph of a crater 50 feet deep made by the explosion of a mine in northern France during the present war shows a remarkable resemblance to Crater Mound. Numerous contour maps and sections show the typical steep inner and gradual outer slopes of the craters, breaking through old beds which are bent up very slightly or not at all, with rims formed of the ejected material. The rims are deposited on ancient lava flows or on sedimentaries, fragments of which are included in the ejecta. Ordoñez is quoted with reference to the Mexican craters. He regarded them as marking the last stages of volcanic activity and the product of igneous action of comparatively slight depth. R. H. JONES.

PHILIPPSON, ALFRED. **Die Erosion des fliessenden Wassers und ihr Einfluss auf die Landschaftstypen.** 36 pp.; diagrs. *Geogr. Bausteine No. 7.* Justus Perthes, Gotha, 1914.

Philippson's essay gives the subject-matter of three public lectures under the above title, and opens with an historical review of the growth of geomorphology. The modern development of the subject, in the author's opinion, has been unfavorably affected by what he considers the undue emphasis on the deductive method and the extreme attempts at classification, involving highly specialized nomenclature, introduced by Davis. There follows a general discussion of the principles of stream action upon different types of land forms and under different climatic conditions, along lines already quite familiar to American students. The essay is illustrated by numerous simple diagrams, and furnishes a good elementary discussion of a subject on which the author is eminently qualified to speak. DOUGLAS W. JOHNSON.